Eng.

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The Engineer.

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The Engineer

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PUBLIC NOTICES

HEATING.

The Commissioners of HIS MAJESTY'S WORKS, &c., are prepared to receive TENDERS before 11 a.m. on Monday, 22nd October, 1928, for ACCELERATED LOW-PRESSURE HOT-WATER HEATING, &c., at the Central Telephone Exchange, Newcastle-on-Tyne.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender, may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to The Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 9725

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
CROSSINGS and SWITCHES and SPARE PARTS.
Tenders due on the 26th October, 1928.
Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 9720

Applications are INVITED by the GOVERNMENT of BIHAR and ORISSA for an APPOINTMENT as a MECHANICAL ENGINEER in the Public Health Department.

Candidates, who should preferably hold an Engineering Degree, must have had wide experience of the manufacture and maintenance of Pumping Plant. Experience in maintaining Electrical and modern Plant for Water Purification also desirable. Age between 33 and 40 years. Pay in accordance with age scale, namely, Rs. 875 a month at 33 years, rising to Rs. 1175 at 40 years, plus (for officers of non-Asiatic domicile) overseas pay of £25 a month, age 33 years, and £30 a month thereafter. Provident Fund. First-class passage for officer and wife. Strict medical examination.

Further particulars and forms of application may be obtained upon request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 17th October, 1928. 9815

Assistant Engineer Required by the GOVERNMENT of HONG KONG for the PUBLIC WORKS DEPARTMENT, for three years' service, with possible permanency. Salary £460, rising to £500 a year by annual increments of £20, and thence (if appointment is made permanent) to £1000 a year, payable locally in dollars under the compensation scheme at present in force at a favourable rate of exchange. Free first-class passages provided. Candidates, unmarried, not over 26 years of age, must have passed the examination to qualify for Associate Membership of the Institution of Civil Engineers, or hold professional qualifications recognised by the Institution as exempting from Parts "A" and "B" of that examination. Must be able to carry out surveys and make all plans necessary for the preparation of details of design, and to prepare bills of quantities for letting of work on contract in connection with road construction, including bridge work in reinforced concrete and the construction of buildings. Candidates must be able to ride a motor cycle.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M.1075. 9696

Assistant Engineers Required by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT, for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. The foregoing officers are required to fill vacancies caused by the increase of the establishment of the Nigeria Public Works Department. Salary £480 a year for the first three years; then £510, rising by annual increments to £920. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 21½ years on the date of appointment, and should preferably have attained the age of 22½, and must not be over 25 years of age. Must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. Examination or have passed the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree or Diploma or Distinction in Engineering as may be considered satisfactory. Candidates whose qualifying diplomas have been obtained without a College course should have had three years' practical experience of Civil Engineering under a qualified Civil Engineer. It is preferred that all candidates should have had two years' practical experience on good Engineering Work, subsequent to taking their degree or completing their articles, but under certain conditions this may be waived in the case of candidates in possession of an Engineering Degree.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, S.W. 1, quoting M/254. 9732

The Government of INDIA REQUIRE TWO INSPECTORS of STORES (Structural), for service in the Indian Stores Department. Candidates must possess a University Degree in Engineering or good general education up to the standard of the Institution of Civil Engineers or of the Institution of Mechanical Engineers, and drawing-office experience, and have served a regular apprenticeship in structural engineering workshops. It is essential that they should have specialised in structural steel and bridge work. Age preferably between 24 and 33 years of age.

Agreement for five years in the first instance. The scale of pay applicable to both appointments is Rs. 500, rising by annual increments of Rs. 50 to Rs. 750 a calendar month, with a personal allowance of Rs. 200 a month and certain other allowances. The selected candidates will be granted a commencing rate of pay within this scale commensurate with their age and qualifications. Free first-class passage to India. Provident Fund.

Further particulars and forms of application may be obtained upon request by postcard to the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 20th October, 1928. 9692

PUBLIC NOTICES

The High Commissioner FOR INDIA is prepared to receive APPLICATIONS for APPOINTMENT as MECHANICAL EXECUTIVE ENGINEER in the Engineering Branch of the Public Health Department, Government of Bengal.

The appointment will be on agreement for three years in the first instance, with possibility of extension. Candidates should be not less than 30 nor more than 43 years of age. They must be corporate members of the Institution of Mechanical Engineers or of the Institution of Engineers (India), or possess equivalent qualifications. They must have had five years' training in the workshops of a first-class machinery manufacturer, and have specialised for not less than five years in the Design, Erection and Maintenance of Waterworks Pumping Machinery, including Filtration Plant.

Pay on age scale. Monthly pay—Age 30, Rs. 650, plus overseas pay £20; ages 31 to 34, Rs. 750, rising to Rs. 850, plus overseas pay £30; ages 35 to 45, Rs. 900, rising to Rs. 1250, plus overseas pay £35. Overseas pay is only granted to Officers of non-Asiatic domicile. Provident Fund. Free passage.

Further particulars and forms of application may be obtained upon request by postcard from the SECRETARY to the HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 20th October, 1928. 9738

The High Commissioner for INDIA is prepared to receive APPLICATIONS for 10 PERMANENT PENSIONABLE APPOINTMENTS as CIVIL ENGINEERS, Burma Public Works Departments, Buildings and Roads Branch.

Candidates must have been not less than 21 nor more than 27 years of age on the 1st August, 1928, and must be unmarried. Preference given to candidates between 22 and 24 years of age. They must have obtained a recognised University Degree and have had at least one year's approved practical experience of Civil Engineering.

Pay on age scale, initial pay for officer 21 to 23 on appointment Rupees 800 a month, rising by Rs. 50 a month to Rs. 1500, plus, for officers of non-Asiatic domicile, overseas pay of £20 a month, rising to £30 when substantive pay reaches Rs. 600, and £40 when pay is Rs. 850 and over. Prospects of promotion. Free passages.

Further particulars and forms of application may be obtained on request by postcard from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 27th October, 1928. 9691

PUBLIC NOTICES

University College of South WALES AND MONMOUTHSHIRE.
COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

A SPECIAL CLASS in METALLOGRAPHY, suitable for persons engaged in Metallurgy, Mining and Engineering, will be held on SATURDAY MORNINGS at the University College, Newport-road, Cardiff.

The Class will commence on October 13th, 1928.

Particulars can be obtained from the undersigned.

D. J. A. BROWN, Registrar.

University College,
Cathays Park, Cardiff,
September 25th, 1928. 9693

Birmingham Central Technical COLLEGE.

APPLICATIONS are INVITED for the POST of LECTURER in METALLURGY. The position is a whole-time appointment, commencing January 1st next. Salary in accordance with the Burnham Scale. Full particulars and form of application may be obtained from the Principal, Central Technical College, Suffolk-street, Birmingham, to whom applications should be sent in on or before November 3rd next.

P. D. INNES, Chief Education Officer.

9628

City of Cardiff Education Committee.
THE TECHNICAL COLLEGE.

PRINCIPAL - - - CHARLES COLES, B.Sc. (Lond.).

The SERVICES will be REQUIRED in January next of a FULL-TIME ASSISTANT LECTURER in ENGINEERING, qualified to teach up to Honours B.Sc. standard. The main subjects required will be those of Mechanical and Civil Engineering, but a good knowledge of Electrical Engineering will be a recommendation.

Salary payable according to Burnham Award.

Applications on foolscap paper, stating age, full qualifications, teaching and other experience, and giving copies of not more than three recent testimonials, should reach the Principal (from whom further particulars may be obtained), on or before Saturday, 13th October.

The successful candidate will be required to pass a medical examination by the Authority's Medical Examiner for Teachers at Cardiff before commencing duties, and to contribute under the Teachers (Superannuation) Act, 1925.

JOHN J. JACKSON, Director of Education.

City Hall, Cardiff. 9567

PUBLIC NOTICES

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that INVENTIA PATENT-VERWERTUNGS-GESELLSCHAFT, of Herrenacker 10, Schaffhausen, Switzerland, a body corporate organised under the laws of Switzerland, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 194,910 granted to Axel Leonard Wenner-Gren for an invention entitled "Improvements in or relating to Vacuum Cleaners."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 26th September, 1928.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. S. JARRATT, Comptroller-General.

P5004

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that GIBBONS BROTHERS, Ltd., a Company organised under the laws of Great Britain, of Dibdale Works, Dudley, in the County of Worcester; MARTIN VAN MARLE and THOMAS EDWARD BRIDGFORD, subjects of the King of Great Britain, of the same address, SEEK LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 291,580, in respect of an invention entitled "Improvements in Muffle Furnaces for Annealing."

Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 26th September, 1928.

Any person or persons may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.

W. S. JARRATT, Comptroller-General.

P5012

APPOINTMENTS BOARD
of the
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.
including:
ROYAL COLLEGE OF SCIENCE,
ROYAL SCHOOL OF MINES,
THE CITY AND GUILDS (ENGINEERING) COLLEGE,
SOUTH KENSINGTON, S.W. 7.

EMPLOYERS REQUIRING MEN who have received a thorough training in the principles of Engineering and who have obtained the Diploma of the City and Guilds (Engineering) College are asked to make use of the services of the Board. Application should be addressed to the SECRETARY; no fees are charged.

These men have received instruction (including practical work in the extensive and well-equipped laboratories of the College) in Civil, Mechanical and Electrical Engineering, including Mathematics, Physics and Chemistry. Their training has been such that they are capable of specialising in any branch of engineering that may be offered. 9697

Bengal-Nagpur Railway Company, LIMITED,

The Directors are prepared to receive TENDERS for
(A) THREE PETROL TANK WAGONS, 5ft. 6in. Gauge.
(B) ONE DECK SPAN GIRDER BRIDGE, 160ft. span.

Specifications and forms of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Wednesday, 3rd October, 1928.

A fee of 10s. will be charged for each copy of the specifications, which is NOT returnable.

Tenders must be submitted not later than NOON on Wednesday, 17th October, 1928.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the orders.

By Order of the Board,
R. C. VOLKERS, Secretary.

9716

City of Hull.
TO STRUCTURAL ENGINEERS.

The Corporation is prepared to receive TENDERS for the CONSTRUCTION and ERECTION of a STEEL OPENING BRIDGE over the Hedon Haven, at a point where the New Paull-road crosses the Haven and on foundations to be erected by other parties.

Forms of Tender and other particulars may be obtained at the City Engineer's Office, Guildhall, Hull, on the payment of £1 1s., which will be returned on receipt of a bona fide Tender. A blue print of the steelwork will be supplied on application at a charge of 2s. 6d., which is not returnable. Remittances to be made payable to Mr. F. Steadman, City Treasurer.

Tenders, endorsed "Tender, Bridge over Hedon Haven, Superstructure," are to be addressed to the Chairman of the Housing and Town Planning Committee, and delivered at the Town Clerk's Office before Twelve Noon on Monday, 22nd October, 1928.

The Corporation does not bind itself to accept the lowest or any Tender.

By Order,
T. THOMAS, City Engineer.

Guildhall, Hull,
5th October, 1928. 9694

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PUBLIC NOTICES

Administrative County of LONDON.
LAMBETH BRIDGE.

The London County Council invites TENDERS from competent firms for the CONSTRUCTION at Lambeth, adjacent to the existing Lambeth Bridge, of a NEW BRIDGE, with Steel Superstructure, Granite-faced Concrete Piers founded in caissons, and Granite-faced Concrete Abutments. The contract will also include the provision of a Temporary Bridge for foot passengers, the Demolition of the Existing Bridge, and the necessary work to the roadways on the bridge and the approaches immediately adjacent.

The documents containing the specification, form of Tender and drawings, may be obtained on or after Monday, 15th October, 1928, on application to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £20 by cheque or draft to the order of the London County Council.

This amount will be returnable only if the tenderer shall have sent in a bona fide Tender, and shall not have withdrawn the same. The documents may, however be inspected before payment of fee at and on personal application to the office of the Chief Engineer.

The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and form of contract, and in the "London County Council Gazette."

No Tender received by the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1, after 4.p.m., on Monday, 3rd December, 1928, will be considered.

The Council does not bind itself to accept the lowest or any Tender.

MONTAGUE H. COX,
9706 Clerk to the London County Council.

County of London.

The London County Council invites TENDERS for the REINFORCED CONCRETE LINING of COAL BUNKERS at the Greenwich Power Station. The specification, drawing, forms of Tenders, &c., may be obtained on application to the General Manager of Tramways, Tramway Offices, Victoria Embankment, upon payment of £2 by cheque or draft to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before payment of the fee. The contractor will be bound to observe the provision of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract, and in "The London County Council Gazette." No Tender received by the Clerk of the Council, The County Hall, Westminster Bridge, S.E., after 4 p.m., on Monday, 22nd October, 1928, will be considered. The Council does not bind itself to accept the lowest or any Tender.

MONTAGUE H. COX,
9713 Clerk of the London County Council.

Royal State Railways of Siam.
NOTICE.

SEALED TENDERS for the SUPPLY of 300 LOW-SIDED STEEL WAGONS, with Spares, for B.E.2471, will be received by the SUPERINTENDENT OF STORES, Royal State Railways of Siam, Bangkok, until Fourteen o'clock on January 15th, 1929.

Blank Tender forms, general conditions, specifications and requisite drawings can be obtained from Messrs. Sandberg, 40, Grosvenor-gardens, London, S.W. 1, upon payment of £1 per set, which will not be refunded.

Right is reserved to reject any or all Tenders.
9684

South Indian Railway Company,
LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. LOCOMOTIVE BOILERS (TWENTY-THREE).
2. BOGIE COVERED GOODS WAGONS (SIX).
3. COPPER RODS and TUBES and BRASS SHEETS, &c.
4. C.I. CHAIRS and DISTANCE BLOCKS.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Ltd., marked "Tender for Locomotive Boilers," or as the case may be, with name of firm tendering, must be left with the undersigned not later than Twelve Noon on Friday, 26th October, 1928, in respect of Specifications Nos. 1 and 2, and not later than Twelve Noon on Friday, 19th October, 1928, in respect of Specifications Nos. 3 and 4.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of Specification No. 1; of 10s. for each copy of the Specifications Nos. 2 and 3; and of 5s. for each copy of the Specification No. 4.

Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France,
3rd October, 1928. 9742

Sir John Jackson, Limited

are prepared to CONSIDER APPLICATIONS for the POST of CHIEF AGENT for the CONSTRUCTION of LARGE DOCK WORKS in the EAST.

Applications, which will be treated in strict confidence, must be in writing, and only those who have held a similar position on large contracts will be considered.

Full particulars as to age, experience, and salary required must be given.

The engagement would be for a period of approximately seven years.

Applications to have the letter "A" on envelope, and addressed—

MANAGING DIRECTOR,
SIR JOHN JACKSON, Ltd.,
53, Victoria-street, S.W. 1.
P5023

Trinity House, London.

APPLICATIONS are INVITED for APPOINTMENT to the POST of MARINE ENGINEER INSPECTOR in the Department of the Surveyor of Shipping and Marine Engineer on the Headquarters Staff at Trinity House.

Candidates must not be over forty years of age, must hold a Board of Trade First-class Certificate as Engineer, and have had experience in Ship Construction and Marine Engine Design.

Salary £300 by £10 to £350, plus Civil Service cost-of-living bonus (at present £114 on £300).

The post (subject to twelve months' probationary service) is permanent and pensionable on the Civil Service Scale.

Applications, with copies of references and full particulars of training and experience, to be made in writing only not later than 17th October, 1928, to the SECRETARY, Trinity House, Tower Hill, London, E.C. 3, and marked outside "Application for Appointment as Marine Engineer Inspector." 9506

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

WANTED, a COMMERCIAL MANAGER, for a Structural Engineering Concern (British) in Calcutta: five years' agreement, remuneration commencing £1000 per annum, with excellent prospects. Previous similar experience, including works, essential.—Apply in writing, with copies of testimonials, to Z.W.676, c.o. Deacon's, Fenchurch-avenue, E.C. 3. All applications will be treated as strictly confidential. 9735 A

WANTED, Active Qualified ENGINEER (Married, aged 28 to 35), Superintend Manufacture large production Cork Insulation, Spain. State experience, salary required.—Address, P5059, The Engineer Office. P5053 A

WANTED, ENGINEER, Age Preferably Between 25 and 35, with experience and up-to-date ideas on Conveying and Elevating Plants. Some commercial experience an advantage; good prospects.—Address, stating age, qualifications, details of past experience, salary desired and when at liberty, 9734, The Engineer Office. 9734 A

WANTED for Patent Agent's Office, ASSISTANT; good technical knowledge, patent experience; qualified man preferred. State age, salary and qualifications.—Address, 9698, The Engineer Office. 9698 A

WANTED, for Shipbuilding Establishment in Hong Kong, ASSISTANT ENGINE WORKS MANAGER. Good training in marine engine design and construction essential; also good general and technical education. Age 28-30. Give full particulars and send copy testimonials.—Address, "ENGINE," Wm. Porteous and Co., Advertising Agents, Glasgow. P4950 A

WANTED, REPRESENTATIVE to Sell Steel Castings in East and West Riding, for company quoting competitive prices. Commission basis.—Address, 9703, The Engineer Office. 9703 A

CHIEF ENGINEER, Age 30-40, REQUIRED for modern Agricultural Machinery Works near Paris. College training and wide technical and practical experience necessary. Applicant must be capable of carrying entire responsibility for all modern installation and equipments; electricity, steam, modern power plants, drawing-office organisation and supervision, tool design. Latest American mass production methods employed. Knowledge French necessary. Excellent prospects for really first-class man. Give full details and salary required.—Box No. 267, Dorland Agency, 65-67, Avenue des Champs-Elysees, Paris. 9726 A

CONSTRUCTIONAL STEELWORK.—REPRESENTATIVE REQUIRED by London firm; must be capable Designer and have connection amongst Engineers and Architects; good salary and commission paid to the right man. State experience and full particulars.—Address, P5024, The Engineer Office. P5024 A

ENGINEER REQUIRED for Large Factory in the Argentine; must be of good standing and education, having had highest grade all-round technical training with subsequent experience of Steam Plant (including Evaporating and Condensing), Electrical (Direct Current), and General Mechanical Engineering. Experience of Process Working and Factory Routine also desirable. Preference will be given to a candidate having a good working knowledge of Spanish, and previous experience in South America. Permanent position with good salary and prospects for suitable man.—Applications, stating age, which must not exceed 35, salary required and qualifications, with copies of testimonials, write to "S.K.," c/o Street's, 6, Gracechurch-street, E.C. 3. 9733 A

HIGHLY TECHNICAL MACHINE TOOL SALESMAN DEMONSTRATOR REQUIRED, preferably with Surface Grinding experience, for North Midlands. State experience, salary required, age, &c.—Address, 9729, The Engineer Office. 9729 A

LONDON REPRESENTATIVE WANTED for Engineering Firm specialising in Steam Power Plant and Colliery Equipment.—Address, P-5029, The Engineer Office. P5029 A

METALLURGICAL CHEMIST, to Take Charge of small laboratory in large works, including Analysis of Metals, Fuels, &c.; must have had sound theoretical training. Experience in Heat Treatment of Steels essential, and of Cold Forging desirable. State age, salary required, and full particulars of experience.—Address, P5010, The Engineer Office. P5010 A

PLANT and DEVELOPMENT ENGINEER WANTED; energetic experienced man, with D.O. experience and preferably knowledge of Steam, Hydraulic, Moulding and Chemical Plant. Progressive post for man of proved ability and initiative.—Apply by letter, giving full particulars of age, experience and salary required, to BERRY, WIGGINS and CO., Ltd., Stratford, E. 15. 9719 A

REPRESENTATIVES REQUIRED to Sell on liberal commission terms, materials used largely in boilermakers, shipyards, collieries and municipalities. Territories vacant—Lancashire, Yorkshire Bristol Channel, and South-East Counties.—Apply, stating ground covered, to H. DAVIES and SONS, Ltd., Worsley-street, Salford, Manchester. P5021 A

WELL-KNOWN FIRM of Power Plant Contractors REQUIRE SERVICES of COMBUSTION ENGINEER, who is well acquainted with various Combustion Appliances, able to Take Charge of Running of Boiler-house Plants and Conduct complete Efficiency Tests.—Address, in first instance, stating age, experience, references, salary expected, 9724, The Engineer Office. 9724 A

WANTED AT ONCE in London Office, TWO or THREE JUNIOR DRAUGHTSMEN, accustomed to detailing Steel-framed Buildings.—Address full particulars, 9619, The Engineer Office. 9619 A

WANTED, First-class DRAUGHTSMAN, for Leading position; experienced in the Design of all types of Conveying and Elevating Plants and the Framed Structures in connection with same. Only those possessing above qualifications need apply.—Address, 9722, The Engineer Office. 9722 A

WANTED, TWO DRAUGHTSMEN, with Experience of Machine Tool Work. State age, experience and salary required.—ALFRED HERBERT, Ltd., Coventry. 9704 A

WANTED, Westminster, TWO MECHANICAL DRAUGHTSMEN. State training, experience, wages, when free.—Address, P5034, The Engineer Office. P5034 A

CAPABLE MECHANICAL DRAUGHTSMAN, with General Engineering Experience, REQUIRED, for works in London area.—Write, stating age, experience and salary required, to Z.X. 677, care Deacon's, Fenchurch-avenue, E.C. 3. 9730 A

CONSTRUCTIONAL DRAUGHTSMAN. Must be energetic and have sound theoretical knowledge and practical experience in all classes of Constructional Steelwork.—Apply, stating age, qualifications and salary required, to MANAGER, Constructional Department, Frodingham Iron and Steel Co., Ltd. 9695 A

CRANE FIRM in the North of England REQUIRES a DRAUGHTSMAN as Part-time Traveller. The position is progressive and offers good prospects to a suitable man. Applicants must be energetic and of good address. State full details of experience, age, and salary required.—Address, 9743, The Engineer Office. 9743 A

DRAUGHTSMAN DESIGNER REQUIRED in the Midlands for Oil Switch Mechanism, &c.; electrical knowledge is not an essential qualification. State age, experience and salary required.—Address, 9686, The Engineer Office. 9686 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9629, The Engineer Office. 9529 A

DRAUGHTSMAN REQUIRED for Mechanical Handling Machinery; only first-class men, capable of developing schemes need apply. State experience, age and salary required.—Address, 9581, The Engineer Office. 9581 A

DRAUGHTSMAN REQUIRED, 30 miles from London; good General Engineering Experience; Oil Engines or Compressors an advantage.—Address, stating age, experience, and salary, 9727, The Engineer Office. 9727 A

DRAUGHTSMAN WANTED. Structures, Elevating, Conveying and General. State salary and when at liberty.—Address, 9711, The Engineer Office. 9711 A

DRAUGHTSMAN, First-class, WANTED for Pneumatic Conveying Work, &c. State salary and when at liberty.—Address, 9712, The Engineer Office. 9712 A

DRAUGHTSMAN URGENTLY REQUIRED, with experience in Structural Steel and Construction Work.—Address, stating age, experience and salary required, P5028, The Engineer Office. P5028 A

FIRM in Midlands REQUIRES Experienced JUNIOR DRAUGHTSMAN, with good mechanical training and some knowledge of Building and Light Steelwork.—Address, giving details of experience, wages required, and age, 9709, The Engineer Office. 9709 A

FIRST-CLASS JIG and TOOL DRAUGHTSMAN REQUIRED. Only those with first-class knowledge of up-to-date Tooling Methods and Rate-fixing need apply. State experience and salary required.—Address, 9705, The Engineer Office. 9705 A

FULLY Experienced AERONAUTICAL DRAUGHTSMEN REQUIRED.—State full particulars and salary required to THE BLACKBURN AEROPLANE and MOTOR CO., Ltd., Brough, E. Yorks. 9646 A

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For continuation of Small Advertisements see page 4.

A Seven-Day Journal

Aeronautical Exhibition.

It is announced by the Society of British Aircraft Constructors that, jointly with the Society of Motor Manufacturers and Traders, it has put in hand the organisation of the seventh International Aero Exhibition, which will be held at Olympia, London, from July 16th to 27th, 1929. The sixth Aero Exhibition was held at Olympia in July, 1920. In March, 1914, there was a combined Aero and Marine Exhibition. Preceding that joint show there was an Aero Exhibition in February, 1913. The very first Aeronautical Exhibition held in this country, or indeed in the world, was that organised by the (Royal) Aeronautical Society at the Crystal Palace in 1868, an exhibition taking part in which was, among others, John Stringfellow, the first person to construct and fly a small power-driven model aeroplane. In past years the International Aero Exhibitions held at Olympia have been international in title rather than in actual fact, for with the exception of one or two French firms they have been supported almost entirely by British undertakings. In general the International Aero Exhibitions held on the Continent have similarly been largely confined to the firms of the country in which they have been held. We are therefore glad to notice that at the International Aero Exhibition to be held at Berlin from October 7th to 21st this year British aeronautics will be represented by several firms and by the Royal Aeronautical Society. The Society will stage an exhibit of historical interest comprising rare books, engravings, drawings, manuscripts, and photographs illustrative of the evolution of flight in Great Britain. Included in the exhibit will be a selection of the papers left by Sir George Cayley, who over a hundred years ago truly laid the foundations of modern aeronautics from the point of view both of the aeroplane and the airship.

Large Supercharged Oil Engines.

In view of the interest attaching to Mr. A. Büchi's paper on "Diesel Engines Fitted with Exhaust Turbine Superchargers," which was read at the World Fuel Conference last week, it may be recorded that successful trials of the motor cargo vessel "Raby Castle," owned by James Chambers and Co., Ltd., of Liverpool, which is the first British vessel to be equipped with the Büchi exhaust turbo charging system have recently been carried out. The "Raby Castle" is propelled by a single-screw eight-cylinder oil engine of the North-Eastern-Werkspoor type, which is designed for a trial output of 3000 I.H.P. at 92 revolutions per minute, the cylinders having a bore of 28¾in. and a stroke of 51½in. The conversion of the engine was carried out at the yard of the engine builders, the North-Eastern Marine Engineering Company, Ltd., of Wallsend-on-Tyne, under the supervision of the owners' consulting engineers, Messrs. Esplen and Sons, of Liverpool. A Brown-Boveri exhaust gas-driven turbo blower has been fitted into the exhaust manifold and delivers air to the cylinders at increased pressure. A feature of the arrangement is the provision for a certain amount of overlap between the opening of the air inlet valve and the closing of the exhaust valve, so that cooling of the exhaust valves is obtained. The amount of increased power secured was only limited in the case of this ship by the existing crank shaft and propeller shaft dimensions, but it is understood that about 30 per cent. increase in power will be available in service, which will be equivalent to an increase in the vessel's speed of one knot. The same builders have other exhaust turbo superchargers under construction for one of the Holt Line motor vessels.

Street Noises.

It is good news to hear that the Ministry of Transport and the Home Office are bestirring themselves in the matter of reducing the noises emitted by street traffic. Within recent years noisiness in our streets and roads has undoubtedly grown appreciably, more so perhaps than those who are daily amongst it fully appreciate. We have in the past emphasised the fact that noise is, generally speaking, a sign of inefficiency, in the source from which it comes, and is a cause of inefficiency in those on whom it is inflicted. The action of the two Government Departments is in the first instance to be directed towards the abatement of motor traffic noise. Draft regulations framed in consultation with the motoring organisations and representatives of public authorities will be published by the Minister of Transport and after they have been confirmed will be enforced by the Home Secretary acting through the police. The police already have power to deal with cases of ineffective silencing on motor vehicles, but have none enabling them to interfere in other cases of noise, such as that caused by the misuse of strident motor horns, rickety cars, defective or badly operated gear-boxes, and so forth. While we welcome this movement for the suppression of unnecessary street noises, we realise that considerable difficulty is almost bound to occur in framing and enforcing satisfactory regulations to secure the end in view. The powers already possessed by the police to take action in such an apparently simple matter as inefficient silencing have been found in practice far from easy to apply. When it comes to suppressing nuisances, such as the abuse of horn sounding, which are wholly arbitrary in their origin, or nuisances, such as an excessively noisy car, which may reasonably be held to be contributed to in large part by the state of the road surface, we cannot persuade ourselves that any regulations which may be framed will prove wholly effective in securing the desired end. Rather must we look to engineers voluntarily to reduce the noise and to the support of motorists and the public to oppose its perpetuation.

A New Nelson Liner.

On Tuesday last, October 2nd, the recently completed motor passenger liner "Highland Monarch," the first of five similar vessels which are being built by Harland and Wolff, Ltd., of Belfast, for H. and W. Nelson, Ltd., left Belfast for London with a party of guests on board. The new liner has a length of 520ft. with a beam of 69ft., and her gross tonnage is about 14,450. She has been specially designed for her owners' South American trade, and the passenger accommodation is of a very high order. The cargo-carrying facilities are of the most up-to-date type and embody new features in refrigerating practice. Five of the holds and most of the 'tween deck spaces are insulated and are fitted for the carriage of chilled meat. A new feature of the refrigerating plant is the employment—we believe for the first time for such a purpose—of four-cylinder horizontal *vis-à-vis* oil engines of the Premier type, which are coupled directly to the ammonia compressors. The main propelling machinery consists of a twin-screw arrangement of eight-cylinder, double-acting, four-cycle engines of the Harland-B. and W. type, while the auxiliary engines comprise four six-cylinder units of the trunk piston Harland-B. and W. type, which are equipped with specially large compressors to enable them to supply the manœuvring air. There is an auxiliary boiler which can be independently oil fired or can be worked from the exhaust gases from either one or both of the main engines.

The Generation of Electricity in Great Britain.

The analyses and summaries of the returns made to the Electricity Commissioners of units generated and fuel consumed at generating stations in Great Britain during the year ending March 31st, 1928, follow the general form adopted in the two preceding years. Summary tables showing the best results as regards average consumption of fuel and thermal efficiency have again been included. As on previous occasions, composite stations containing more than one type of prime mover have been classified in accordance with the type of plant by which the major portion of the output was generated, and similarly in arriving at the average consumption of fuel per unit generated in the case of stations where more than one class of fuel was consumed, the actual fuel consumption at each station has been converted on the basis of average calorific values into an equivalent tonnage of the class of fuel from which the largest output was obtained. Returns were received in respect of 570 generating stations, the same number as in the previous year. The total number of units generated at these stations during 1927–1928 was 9,927,850,630, an increase of 18·7 per cent. on the figures for the previous year; and the total coal, coke, and fuel oil consumed was 9,224,151 tons, or an increase of 4·1 per cent. In seeking to draw comparisons with the previous year, however, regard must be paid to the adverse effect of the prolonged coal strike in 1926–1927 upon the output and operating results in that year. The station with the highest thermal efficiency in all the various groups is the Barton station of the Manchester Corporation, which had an efficiency of 21·07 per cent.

The Singapore Dockyard Contract.

It was announced by the Admiralty on Friday last that the firm of Sir John Jackson, Ltd., of 53, Victoria-street, Westminster, had been awarded the contract for the main works in connection with the new naval base at Singapore. This contract, it is understood, covers the construction of roads, railways, wharves and other plant, and will be one of the largest naval dockyard undertakings carried out for many years past. The estimated cost of all the purely naval work at the new base is £7,750,000, but the contract just placed represents, of course, only a certain proportion of this total. Some interesting details of the base have also been officially published. It is to be laid out along the excellent harbour which has been formed on the old Johore Strait—on the northern side of the island of Singapore—by the construction of the stone causeway that links the island railway with the mainland of Malaya. This harbour is completely sheltered, and will afford excellent anchorage and berthing facilities for the largest ships. The huge floating dock, now on its way out to Singapore, is to be moored some miles above the entrance to the harbour, and abreast of it a basin is to be constructed in which auxiliary vessels can be berthed to discharge their cargoes. Besides the floating dock there is to be a very large graving dock, capable of receiving two of our heaviest capital ships at once. Other features of the new base will be an electric generating station, workshops, a foundry, and powerful cranes. Mr. L. H. Savile, C.B., M. Inst. C.E., Civil Engineer-in-Chief to the Admiralty, is responsible for the design of the permanent naval works. It is specified in the contract awarded to Sir John Jackson, Ltd., that the work shall be completed in seven years.

St. Paul's Bridge.

In a Journal note in our issue of August 24th we indicated that the Bridge House Estates Committee of the Court of Common Council for the City of London would probably propose to meet the objections advanced against the carrying out of the St. Paul's Bridge scheme by deviating the northern approach from the originally proposed line through the eastward end of St. Paul's Churchyard to an extent that would remove all fear of damage being caused to the Cathedral by the vibrations set up by the traffic using the bridge. The Bridge House Estates Committee has now circulated its report on the subject. Our anticipation was correct. The proposed deviation shows the first half of the northern approach curving eastwards to such an extent as to bring it at least 200ft. away from any part of the Cathedral. Mr. Basil Mott, the Committee's consulting engineer, who has also been acting for some years past in the interests of those concerned with the preservation of the Cathedral, approves of the proposed deviation and regards it as the only really practical suggestion which can be advanced. The existing parliamentary powers possessed by the Committee authorising it to construct the St. Paul's Bridge in accordance with the plans originally prepared expire on April 27th, 1929. It recommends that an extension of time be sought and that parliamentary powers be obtained to acquire the property necessary for the proposed deviation. Beyond that deviation the scheme of the bridge remains unaltered.

Two New Airships.

It is reported from Washington that the contract for the construction of the two new naval airships, each of which is to have a gas capacity of 6½ million cubic feet, will be awarded to the Goodyear Zeppelin Company, of Akron, Ohio. The work covered by the contract will be the design and construction of the airships, and for it the company's tender is stated to amount to £1,590,000. The Goodyear Zeppelin Company was formed some years ago to take over the rights of the German Zeppelin Company when that company was threatened with extinction by the Allies after the war. Subsequently the German company found it possible to continue in business and since the war has produced two airships at its Friedrichshafen works, the LZ 126—now the United States airship "Los Angeles"—and the recently completed LZ 127, or "Graf Zeppelin." The Goodyear Company, in spite of the change in the circumstances of the German company, has apparently retained the right to manufacture airships on the Zeppelin principles. The price to be paid for the new airships seems very high, even allowing for the fact that they will be 1½ million cubic feet larger in capacity than the British airships R 100 and R 101, at present the largest vessels in existence or ever constructed. The R 101 is being built at a cost estimated at about £500,000, but included in that figure is expenditure on a very large amount of development work. A second vessel of the same or similar size could probably be built for £200,000 to £300,000. The American airships, with all the resources and development work of the German company behind them, should be, one would have thought, capable of being constructed at much less than round about £800,000 each.

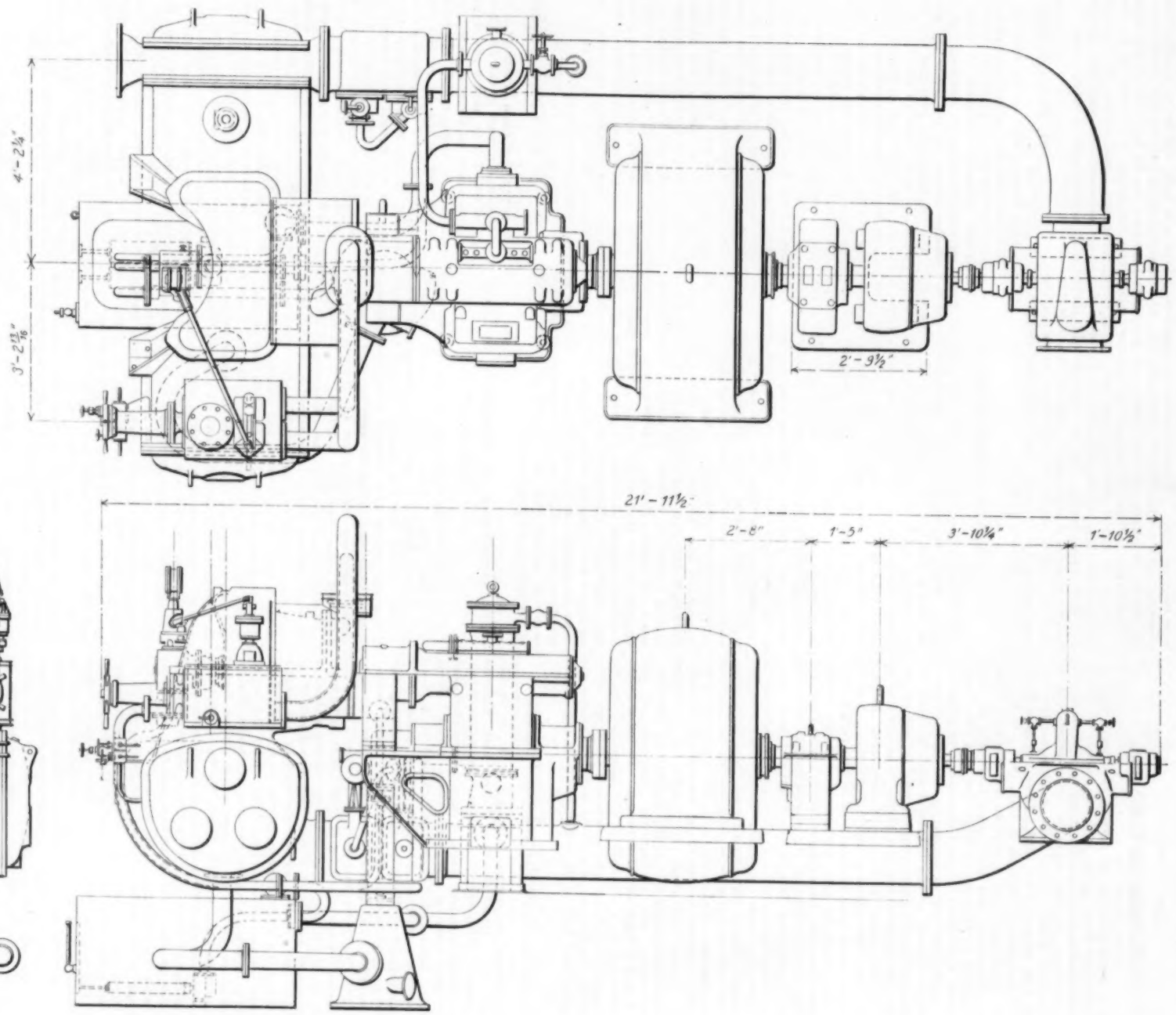
A Notable Clydebank Launch.

On Friday last, September 28th, their Royal Highnesses the Duke and Duchess of York visited the shipyard of John Brown and Co., Ltd., at Clydebank, and at 12.30 p.m. the Duchess launched the Canadian Pacific express liner which bears her own name. The new liner is a sister ship to the "Duchess of Richmond," which was launched at the same yard on June 18th and she was berthed alongside that ship. She is the last of four liners of the "Duchess" class, two of which, the "Duchess of Athol" and the "Duchess of Bedford," are already in service. The length of the ship is 600ft., with a beam of 75ft. and a depth of 63ft. from the keel to the bridge deck. The gross tonnage is about 20,000 and the lines of the hull are slightly finer than those of her sister ships, which fact, it is contemplated, will enable her to maintain a service speed of 18½ knots, being an increase of a knot and a-half over the speed of the three other vessels. The propelling machinery is of the single reduction geared turbine type, the steam being supplied from six water-tube boilers, which have been constructed by the builders to Messrs. Yarrow's designs. They have a working pressure of 370 lb. per square inch. This particular installation is of special interest, as the boilers are of a higher pressure than usual and the steam temperature is also higher.

1000 kW SELF-CONTAINED TURBO-GENERATOR

THE METROPOLITAN-VICKERS ELECTRICAL COMPANY, LTD., MANCHESTER, ENGINEERS

(For description see opposite page)



"THE ENGINEER"

The Metropolitan-Vickers Self-contained Turbo-Generator.

Turbo-generating units, at any rate so far as moderate powers are concerned, have up to the present followed a practically standardised lay-out, evolved by the simple process of connecting together the various pieces of apparatus necessary for the operation of the plant. The turbine and generator rest generally on substantial concrete foundations with the condenser in a basement; the circulating pumps are arranged where convenient on the lower floor; while steam ejectors, oil coolers, &c., are placed where room may best be found for them. Not only does the usual lay-out occupy a great deal of space and require a supervision of machinery on two floor levels, but it involves also separate motor drives for the circulating and condensate pumps with the consequent risk of interruption of these essential auxiliaries. The arrangement is far from ideal, whether regarded from the standpoint of cheapness of installation, ease of operation, or mechanical efficiency. Indeed, in the case of the smaller machines, as required for industrial power or for work on shipboard, the defects of the standard lay-out are sufficient in many instances to lead to the installation of some competitive type of prime mover, thus limiting the employment of steam turbine machinery in fields which otherwise would be peculiarly its own.

The problem of the design of small and medium-sized turbo-generating sets for ordinary industrial purposes has been thoroughly studied by the Metropolitan-Vickers Electrical Company, of Manchester, with the result that the firm has recently developed a series of machines which appear to constitute a notable advance on anything in the way of turbine machinery previously available for works or shipboard use, or even for the smaller power stations. The new design comprises a radical departure from what may be called the standard lay-out. The turbine and condenser have been combined into one unit, the auxiliaries are mechanically driven from the main shaft, instead of straggling all over the place, and the compactness thus obtained eliminates the necessity for a basement and even for foundations as ordinarily understood. The driving of all auxiliaries direct from the set greatly simplifies starting and operating and results in a higher efficiency as well. Efficiency, indeed, has been studied with the same care as compactness and simplicity, and the use of a small high-speed turbine geared to a low-speed alternator permits of both the steam and the electrical end being designed each for its best performance. Finally we may add that the set is provided with a special type of governor gear of extreme sensitiveness, giving perfect governing in spite of the small "fly-wheel effect" of the rotating parts.

The new self-contained turbo-generator units are built, so far, in sizes ranging from 300 kW to 4000 kW. All sets are similar in principle and differ only in the details of design. The view on page 376 which shows a set rated at 1000 kW illustrates the general appearance of the type. The drawings on page 364 show the arrangement of the plant to scale. These illustrations convey, better than words, an idea of the simplicity and compactness of the arrangement. The combination of the turbine and condenser is effected by having the upper half of the condenser casing or, in some sets, the whole of the condenser casing cast integral with the lower half of the turbine casing. The combined unit is supported at the H.P. end by a specially strengthened bearing on the gear-box and at the L.P. end by flexible I beams under feet provided on the condenser casing. The alternator, exciter and circulating pump are all coupled in line and driven from the slow-speed shaft of the reduction gear. The extraction pump in this set is driven by gearing from the slow-speed shaft of the reduction gear at the turbine end of the gear case, and the oil pump is arranged immediately below the governor gear and driven by an extension of the vertical spindle. In the smaller units the position of these two auxiliaries is interchanged. The air ejectors are of the steam-operated type and are mounted on the circulating water pipe near the intake to the condenser.

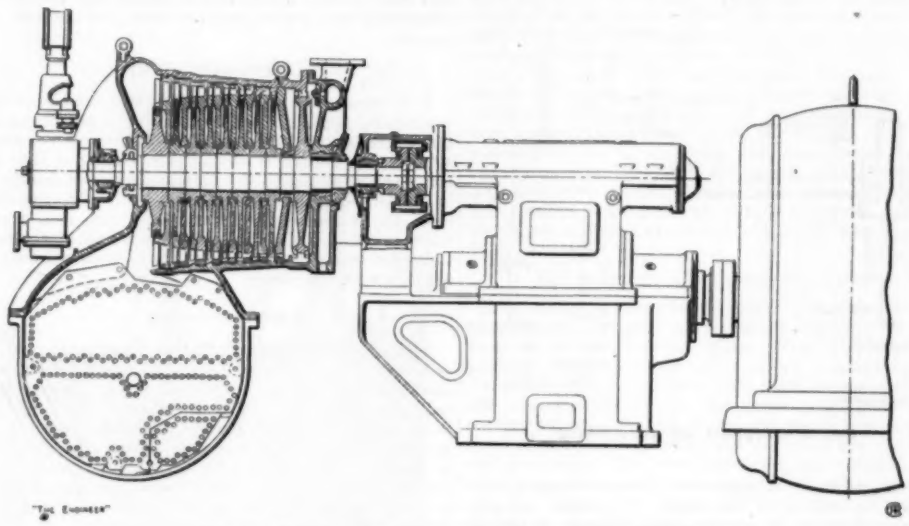


Fig. 1—Section Through Turbine and Condenser

Turbine.

The turbine, shown in section in Fig. 1, is designed to give its rated output at 5000 r.p.m and is suitable for a wide range of steam conditions. It is of the single-cylinder impulse type, having one velocity stage and eight impulse stages. The cylinder is divided on its horizontal centre line and the top half is split into two sections. Cast steel is employed where the steam conditions render this desirable.

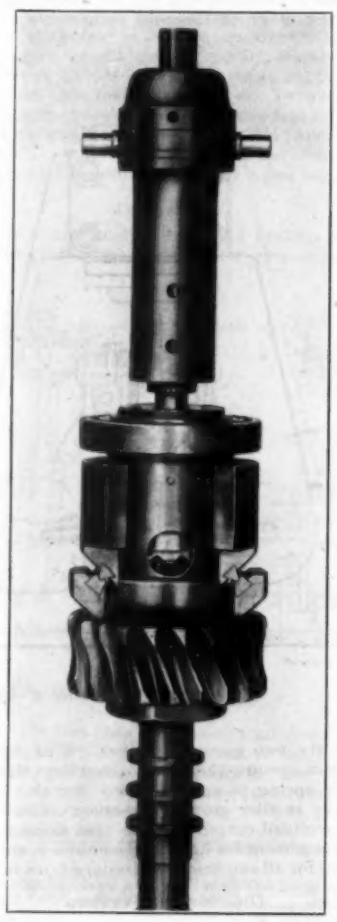


Fig. 2—Governor for 1000 kW Turbine

The diaphragms are of cast iron with cast-in blades or, where necessary on account of steam conditions, of the built-up type with machined guide blades and steel centres. The diaphragm glands are of the labyrinth type. The high-pressure spindle gland consists of a multi-throttling labyrinth steam gland and a Metrovick water-sealed gland which has an impeller rotating in a race fed with water. The low-pressure gland consists of a water paddle of the usual type. The nozzles are built up of steel angles and accurately fitted vanes and are machined all over. They are arranged in two groups separately supplied with steam and controlled by separate valves. One group of nozzles provides for an output up to the economic rating of the turbine, the other group providing for additional load above this value.

The rotor consists of forged steel wheels, machined all over, pressed on to a mild steel shaft and driving through substantial keys. The first wheel carries two rows of blades compounded for velocity. The other wheels each carry a single row of blades. The blades are of 5 per cent. nickel steel with the exception of those at and near the dew point, which are of stainless steel. The steam chest is of cast steel or cast iron, according to the steam conditions. It is supported by the condenser and connected to the turbine cylinder by two pipes which are arched to take up expansion. It is fitted with a combined stop and emergency valve, a steam strainer and two automatic governor valves which are operated by oil relay and control respectively the supply of steam to the two groups of nozzles. By an ingenious mechanical arrangement the sequence of opening of the governor valves can be changed by a single movement of a hand lever. This forms a convenient provision for meeting partial load with reduced throttling loss.

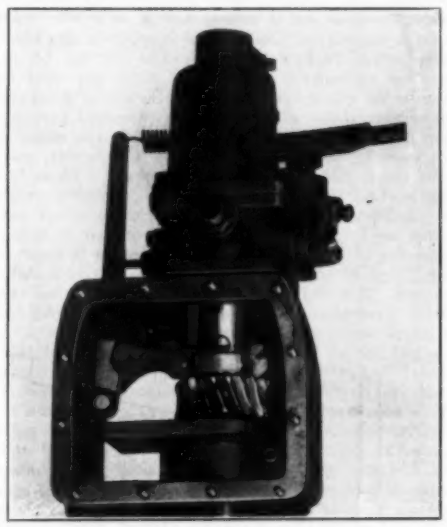


Fig. 3—Governor in Casing

Governor.

The governor is of a very interesting type introduced some years ago by the Metropolitan-Vickers Company for the regulation of high-speed turbines. In this connection it is important to note that the modern tendency to increased output at given speeds of turbine operation has necessitated a reconsideration of methods of speed regulation. The reason for this is that the comparatively small mass and diameter of the high-speed rotor make its fly-wheel effect much less than that of the larger slower speed machines formerly used. This reduced inertia necessitates speed regulating gear of extreme sensitivity and rapidity of action. It was primarily in order to meet this requirement of increased speed of action for high-speed machines that the development of the new Metrovick governor was undertaken. The success which the makers have experienced with the type of governor used on these sets has led them to extend its application to a considerable proportion of the turbines they manufacture, including machines of much larger output than those here described.

Fig. 2 shows the new governor as designed for the 1000 H.P. turbine, while Fig. 3 illustrates the same in position in its housing. The sectional drawing—Fig. 4—illustrates the mechanism more clearly, while the diagram—Fig. 5—makes clear the action of the apparatus. Control is effected by means of an oil relay valve which is operated by the governor, and regulates the oil pressure in a power piston operating the valves. A compensating sleeve device on the relay valve is adjusted by a lever coupling from the power piston. This provides the differential system essential to stable relay governing. An important feature of the arrangement is that the oil relay valve rotates with the spindle while the compensating sleeve is free to rotate between the valve and the casing, thus reducing to a minimum the friction resisting vertical movement.

The detail of the governor mechanism is shown in Fig. 4. The vertical spindle is driven by worm and wheel from the turbine spindle. Besides operating

the governor itself, it is extended downwards to drive the turbine oil pump, and is keyed loosely at its upper end to the tachometer spindle. The weight of the rotating parts is carried on a collar thrust bearing just below the worm wheel, while free running is obtained by the ball bearings just above the two governor weights. The governor weights are of modified L shape and are pivoted on knife-edges. Fig. 4 shows the weights in position as at rest while Fig. 5 shows them in the running position, lifting the upper part of the spindle against the pressure of the spring. This part of the spindle carries the relay piston, which is retained in position by a nut above, and held to the rotation of the spindle by a key at its lower end. The relay piston is so shaped as to provide communicating channels between four oil supply and drain chambers A, B, C, D. Of these B is the oil pressure chamber connected to the supply from the oil pump, C is a control chamber connected to the underside of the power piston, while A and D are oil pressure release chambers. According to the amount of communication effected between these chambers the power piston is raised and increases the opening of the governor valves or is allowed to

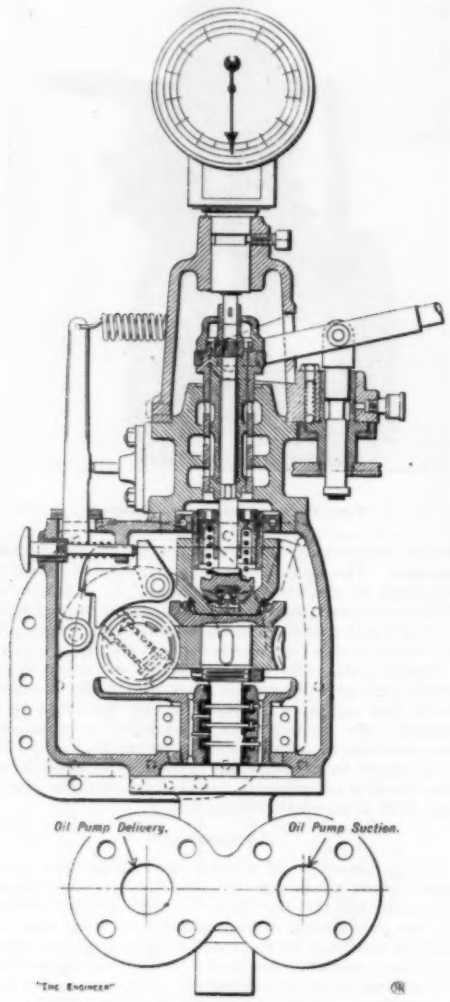


FIG. 4—SECTION THROUGH GOVERNOR GEAR

fall and reduces the opening. The amount of communication between the various chambers is controlled by the rise and fall of the relay piston and modified by ports on the compensating sleeve, which fits loosely round the piston and is raised or lowered by a lever coupling from the power piston which operates the governor valves.

When the turbine is running the whole of the spindle from the oil pump to tachometer, including the relay piston, rotates together. The compensating sleeve rotates slowly owing to the friction of the oil film between the piston and the sleeve, this rotation preventing any stickiness in the vertical movement of the sleeve relative to either the governor casing or the relay piston. Should increase occur in the speed of the turbine, owing, for example, to falling load, the weights swing further from the spindle and their lower ends lift the relay piston. This opens the port from the oil chamber C to the pressure release chamber D, allowing oil to escape from under the power piston, which falls and reduces the governor valve opening. The interconnecting lever from the power piston at the same time raises the compensating sleeve and gradually reduces the port opening until equilibrium is reached and the port is closed. In the case of falling speed the relay piston moves downward, opening the port from the pressure chamber B to the control chamber C. The oil pressure thus applied raises the power piston, which increases the governor valve opening, the movement being compensated by the sleeve as before. Speed adjustment can be obtained by the hand speeder gear shown, which by moving the fulcrum point of the compensating lever alters the relative position of the relay valve and the power piston.

The close association of the governor and relay valve elements is one of the notable features of the construction, the extremely rapid communication which is thereby effected between the governor and the governor valves giving a very close speed regulation with no trace of hunting.

Additional safeguard against overspeed is provided by a bolt type emergency governor, which is shown in Fig. 4, mounted in the turbine spindle. The spring-retained bolt, when moved out by excessive

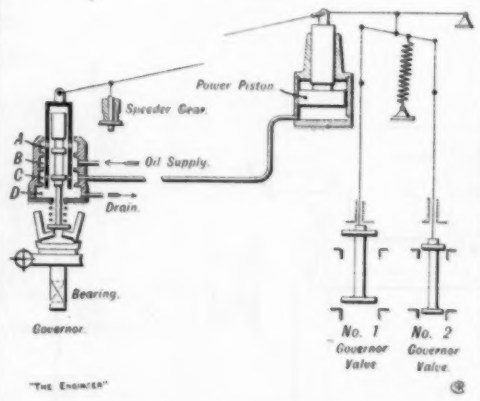


FIG. 5—DIAGRAM OF GOVERNOR

centrifugal force, engages with a lever which is connected to valves in the relay oil pressure system. These valves effect an immediate release of the oil pressure in the relay system without, however, reducing the pressure of the lubricating oil. The release of oil pressure not only closes the governor valves by means of the power piston already mentioned, but also releases an emergency trip device on the main stop valve. A hand trip device with push knob is also provided to operate the emergency trip lever.

The operation of the valve sequence changing device already mentioned may best be explained by reference to Fig. 5. By a simple hand lever movement the pull of the governor spring can be transferred to one side or the other of the mid point on the linkage between the two governor valves. This determines the order of opening the valves, since the valve remote from the spring is opened first. By this selective device the smaller group of nozzles, ordinarily used for the overload output, can be used alone as an efficient arrangement for light load conditions and throttling losses for all conditions are reduced to a minimum.

Oil Supply System.

The supply of oil for operation of the governor relay valve and power piston, and for lubrication of the main governor parts, the speed reduction gear and the turbine and gear bearings, is maintained at pressure by the oil pump already mentioned, which is driven from the governor spindle.

The pump is of the rotary gear valveless type, drawing oil from a tank placed beneath the condenser. The supply to the relay valve is delivered direct, but the supply to the bearings is through an oil cooler, the oil flowing back to the tank by gravity. An auxiliary pump is provided for flooding the bearings on starting up.

Condensers.

The condenser is of the surface type, arranged for the steam to flow over and the water through the tubes. The shell is usually of cast iron and there is a cast iron water-box, provided with inlet and outlet branches for the circulating water and arranged with end covers having suitable inspection doors. The tubes are of solid drawn brass secured in rolled brass plates by screwed ferrules and tape packings. The tube-plates are stayed internally and held against the shell flanges by a number of collar bolts. A suitable steel baffle plate is fitted to ensure that the incondensible gases are cooled on their way to the air ejector.

Circulating Pump.

The circulating pump fitted as standard is of the centrifugal type. It is connected by a flexible coupling to the exciter shaft, or in the case of direct-current sets, to the generator shaft. The casing is split on the horizontal centre line, the suction and discharge branches being on the bottom half. The impeller is of the double-entry hydraulically-balanced type; made in gun-metal and mounted on a mild steel shaft, the shaft being protected by bronze sleeves where in contact with the water.

Extraction Pump.

The extraction pump, which is illustrated in Fig. 6, is of the vertical type, and is arranged with a split casing to enable the impeller to be conveniently examined and removed if necessary. The impeller is of hard phosphor bronze of the single entry type, mounted upon a stainless steel shaft. On the shaft is mounted a ball bearing housing containing the thrust and journal bearings. The housing is designed to come away with the impeller shaft, so that this is not disturbed if the rotating element has to be removed. The pump casing is so designed that there is incorporated a chamber which is connected to the discharge of the pump, and through which the shaft passes prior to passing through the casing at the stuffing-box. This positively sealed gland effectually ensures the elimination of air leakage and the troubles connected with lantern rings.

The shaft is provided with a conical taper for the reception of the flexible coupling, which is of the multiplate type. The pump is securely fastened to the foundations and the flexible coupling referred to, together with another flexible coupling at the top

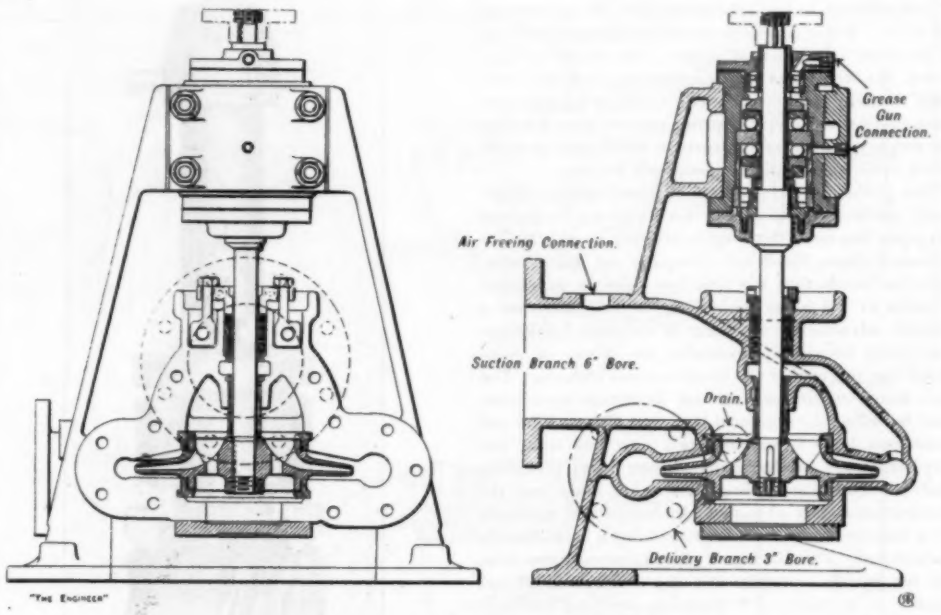


FIG. 6—VERTICAL CONDENSATE PUMP

end of the vertical shaft driving the pump, provide all necessary allowance for expansion.

Air Ejector.

The air ejector is shown in Figs. 7 and 8. It is of the two-stage steam-operated type, provided with inter and after coolers of the surface type. Simplicity of operation has been given prior consideration, and for this reason the ejector has been mounted in the circulating water main leading from the discharge of the circulating pump to the inlet of the condenser. The inter and after coolers consist of U-shaped tubes of solid drawn brass, the steam passing inside the tubes and the circulating water externally. The tubes are expanded into a rolled brass tube plate, to which is also attached the casting that carries the bronze parts of the ejector proper. The chief advantage of having the ejector mounted in the circulating water main is that, on starting up the set, the cooling medium is immediately available, since the circulat-

ing water pump is coupled to the generator shaft and commences to circulate water as soon as the turbine commences to rotate. Full vacuum is thus built up very rapidly. Each stage of the ejector is provided with a steam operating valve and the necessary gauge, which is conveniently mounted at the turbine end of the set. The gauge board carries also the other instruments comprising steam pressure, vacuum and oil pressure gauges.

SPEED REDUCTION GEAR.

A speed reduction of 5000/1000 r.p.m. is given by a gear of the double helical single-reduction type, arranged with the pinion vertically above the wheel. On page 376 is a view of the gear with the top half of the casing removed. The pinion is integral with

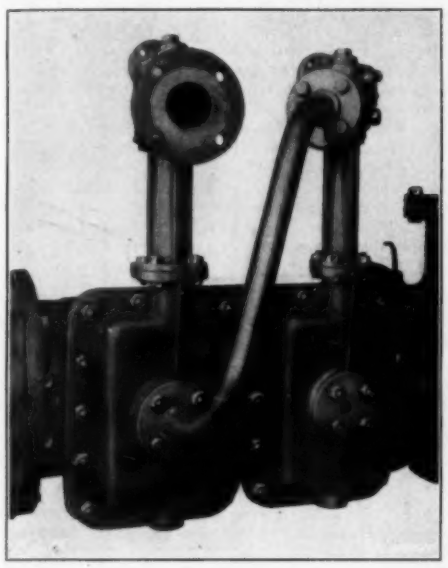


FIG. 7—TWO-STAGE AIR EJECTOR

the high-speed shaft, the whole being machined from high-quality alloy steel. It is connected to the turbine by a flexible coupling of the Wellman-Bibby type manufactured by the Metropolitan-Vickers Company under licence. The gear wheel consists of a cast iron centre piece with a shrunk-on forged steel rim, the wheel being hydraulically forced and keyed on to a mild steel shaft. The teeth of both the pinion and the wheel are of involute form, hobbed on a machine which has been modified by the Metropolitan-Vickers Company to give an exceptionally high degree of accuracy. The gear bearings are of the rigid type, having split cast iron bushes lined with white metal and lubricated by oil under pressure. The inboard high-speed bearing is designed to carry part of the weight of the turbine unit as already

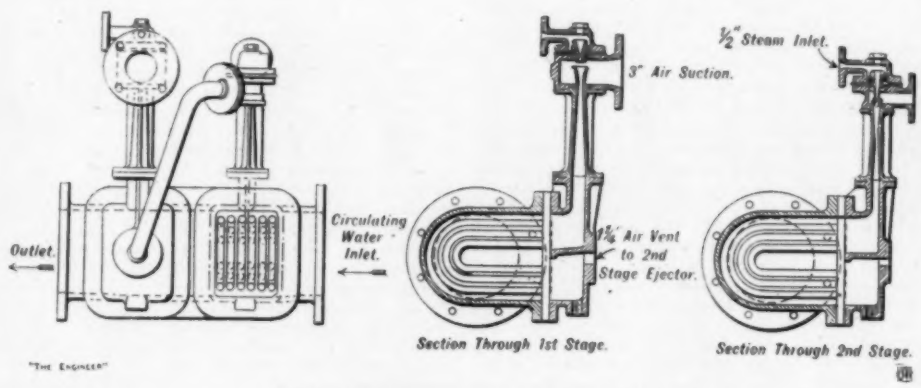


FIG. 8—ARRANGEMENT OF AIR EJECTOR

mentioned, and the outboard slow-speed bearing carries part of the weight of the generator rotor.

GENERATOR.

The sets can be supplied with either alternating-current or direct-current generators as required. In either case the machine is connected by solid coupling to the slow-speed shaft of the gear and supported on that side by the gear bearing, as described above.

The set illustrated includes an open protected type alternator with its exciter. These alternators, which are of the Metrovick standard design, can be supplied for the 1000-kW set in standard voltages up to 6600 volts. They are of the salient pole type, the rotor consisting of a single steel casting having the poles integral with the rotor body, which is pressed on to the shaft. The stator is a box type casting with internal ribs supporting the steel stampings which form the core. The windings of high-voltage machines are usually of the diamond-coil type, formed and insulated before being placed in the open slots. In low-voltage machines the windings are usually of the barrel type, consisting of mica-insulated bars pushed through semi-closed slots and afterwards bent to shape.

The exciter is of the open protected type, the armature being carried on an extension of the alternator shaft without outboard bearing. It is a simple shunt-wound machine designed for stability over a wide range of voltage under the control of a shunt field rheostat. The brush gear is carried on a bracket supported from the bearing pedestal.

For direct-current generation, with the size of turbine here described, a 1000-kW machine of the open type for voltages from 440 to 600, arranged with shunt, level or over-compounded windings, is supplied as standard. The field is of cast steel with split yoke, having laminated iron poles and forged steel or laminated interpoles bolted on. The shunt coils are former-wound and the series interpole coils are usually of copper strap wound on edge and insulated with fullerboard and empire cloth. The core is built up of punchings carried on a spider, which is keyed to the shaft, the commutator being usually carried on a separate spider. The armature coils are former-wound of mica-insulated copper strap. The brushes are carried in sliding box-type holders which are mounted on a rocker ring carried from the yoke.

FOUNDATIONS AND BUILDING SPACE.

The design of the new sets offers a final important advantage in respect of its small requirements of foundations and building space. The usual type of turbo set requires a foundation of two concrete walls, 2ft. to 3ft. thick and 12ft. to 14ft. high, between which are accommodated the condenser and generator cooling equipment, and across the top of which is a steel joist reinforced platform carrying the turbine and generator. The new Metrovick set, owing to its comparatively small dimensions and light weight, and its extremely compact arrangement, requires merely a concrete floor reinforced with steel joist grillage with a small pit of about 2ft. 6in. in depth for the condenser and oil tank. The saving in this respect is increased by the simplicity of pipe and cable connections, as compared with the expensive construction of ducts through concrete foundation walls. It is estimated that the total foundation cost for the 1000-kW set here described is only about one-sixth of the foundation cost for an old type set of equal capacity.

Valuable saving is also effected in building cost owing to reduced height requirements. Needing no basement, the set can be accommodated in a building about half the height of that required for the old types, the saving in height being actually about 12ft. to 14ft. The important saving in installation cost which results from this feature should not be overlooked. The saving in space is even more marked in the case of the two smaller sizes, the 300-kW and 500-kW sets, which occupy only about 30 per cent. of the space required for old-type sets of equal capacity.

OPERATION.

The set is extremely robust and flexible in operation. Its properties in the latter respect are illustrated by the fact that after being shut down with all valves on the whole system closed, it can be run up to normal speed ready for load in less than one minute, an operation which we saw performed without the least difficulty or hurry.

BARCELONA has been equipped with the latest system of automatic telephones, and has been linked up with Madrid and nineteen other cities situated in all parts of Spain through a modern toll switchboard. The programme of the Compania Telefonica Nacional De Espana covers the conversion of nineteen cities to the automatic system in two years. The rotary type of automatic plant has been installed. It consists of 26,000 lines situated in four specially constructed telephone buildings. In connection with the institution of Barcelona's system, demonstrations were given of the long-distance telephone, and a call was made to Madrid. Long-distance telephone communication in Spain is considered to be of the greatest importance by the Spanish Government and Spanish business men; 3500 miles of toll circuit are employed.

World Fuel Conference.

No. II.*

COAL TREATMENT, CLEANING, DRYING AND BRIQUETTING.

ON Wednesday morning, September 26th, a group of seven papers, dealing mainly with methods of coal cleaning, were discussed together by Section C under the chairmanship of Professor R. V. Wheeler.

In a paper, entitled "*The Cleaning of Small Coal*," the author, Dr. W. R. Chapman described briefly the various methods employed to clean coal too small for economical hand picking. He expressed the view that washing coal was more efficient than dry cleaning, though dry cleaning was almost essential for unscreened Durham gas coal, which had to be carbonised in horizontal retorts. On the other hand, since water was frequently added to small coal before burning, the wetness of nut coal due to washing was seldom any disadvantage. The two cheapest cleaning processes were the Baum and the Rheolaveur, which should not cost for operation and maintenance more than 3d. per ton of raw coal for a plant dealing with 100 tons per hour. Processes depending on concentrating tables or pneumatic separators were more expensive, because the coal had to be sized, and numerous units were necessary. As to froth-flotation processes, the power consumption was heavy and the total costs apparently high. The chief cost, to a colliery company, of cleaning was due to the fact that some of the material raised had to be discarded. In general, to reduce the ash content to 6 or 7 per cent., the rejected material must contain 60 or 70 per cent. of ash, and the output would be reduced by 1½ per cent. for every 1 per cent. reduction in ash. Figures were given to show that unless the consumer would pay a substantial premium for very clean coal, it would be commercially impossible to reduce the ash content from 6 to 3 per cent.

A new type of coal-cleaning apparatus was described in a most interesting paper by Geo. Raw and F. F. Ridley, entitled "*The Principles of Pneumatic Separation with a Description of the Static Dry Washer.*" Instead of effecting stratification by vertical air currents through the coal sufficiently strong to cause the separation of the lighter coal particles from the heavier stone, a new principle is adopted in the Raw apparatus. It was found that when a closely packed "piston-like" bed of coal varying in size from 1¼in. to 0, on an oscillating pervious support was subjected to a certain critical air pressure from beneath, the bed became distended and assumed a sort of fluid character. Under these conditions, stone particles of various sizes placed on the surface sank slowly to the bottom of the coal. The critical pressure was 0·67in. w.g. for every inch depth of bed. Once stratified, the clean coal could be separated from the dirt by means of skimmers. Plants working on this principle were in commercial operation in several English collieries, with a total cleaning capacity of 280 tons per hour. Working results over lengthy periods showed that an ash content of 11·97 per cent. in the raw unsized coal was reduced to 6·9 per cent., the ash in the refuse being 68·5 per cent. The free coal in the refuse represented a loss of only 1 ton per 1000 tons treated. At the South Hetton Colliery, the power for the plant with conveyors was 0·85 kWh, and the total costs, including capital and depreciation 3·242d. per ton of raw coal treated. The principles of the froth-flotation process were described by E. Edser and P. T. Williams, in their paper on "*The Cleaning of Coal by Froth Flotation.*" About 0·75 lb. of cresol and 0·5 lb. kerosene per ton of coal would usually suffice to cause frothing, and about 3 H.P. hours were required per ton of coal treated. A plant which had been working since 1924 at Bargoed Colliery treated coal below 2 mm. in size, containing 22 per cent. ash, and produced a concentrate with only 4·5 per cent. ash, and residues containing 70 per cent. ash. From the flotation concentrates of Durham coal, a coke with only 1·9 per cent. of ash had been produced.

Dr. R. Lessing, Vice-Chairman, who opened the discussion, said that during the last three or four years the cleaning of coal dry without the addition of water had made great progress, particularly in this country. It would be very useful to consider the claims made for the two kinds of cleaning coal, viz., wet washing and dry cleaning, even if the point could not be settled as to which was the best. Major Appleyard, in his paper, pointed out that dry cleaning was not yet applicable where very clean coal was required, but was mainly intended for the partial removal of the refuse to about 4 or 5 per cent. above the fixed ash content in the coal. That was the position to-day, although no doubt advances would be made which would improve it.

Mr. G. Lambourne (Cardiff), speaking on the question of cost, remarked that wet cleaning was efficient but expensive. In the case of two washeries in Durham and South Wales the cost of wet cleaning coal was 3s. 4d. and 1s. 2d. per ton respectively, and although Dr. Chapman in his paper referred to a cost of 3d. per ton, washeries where that was possible were very few and far between. On the other hand, he claimed that the cost of dry cleaning could be brought to below

* No. I. appeared September 28th.

3d. per ton; that figure related to actual practice in cleaning small coal, and it included both capital and operating costs. The advantage to the consumer was considerable, because in one case of a consumer using about one million tons per annum he had found that by dry cleaning the coal an increase in the calorific value of 7 per cent. was obtained and in another case 9 per cent. Dry cleaning was preferable to wet washing, because it had the capacity for dealing with the whole of the coal, whereas wet washing could not deal with the fines. That was the second advantage of dry cleaning, and the third was that it satisfied the necessity for a low moisture content. Dry cleaning could provide modern coke ovens with a dry coal and so decrease the coking period. To extract the maximum percentage of ash from coal involved grinding the coal to the finest possible state, because the ash was bound up with the coal. He had recently dry cleaned coal of a size of 1¼in. to 0in., coal which contained inseparable ash amounting to 13·8 per cent., a figure which, after grinding to ¼in., was reduced to 8 per cent. Wet washing could not get down to within 2 per cent. of the fixed ash, whereas with a dry cleaning process he had got down to 1 per cent. of the fixed ash.

Professor Douglas Hay remarked that in South Yorkshire practically the whole of the slack and small coal passing ¼in. mesh was carbonised in high-temperature ovens. It contained, in its raw condition, about 15 per cent. of ash and some 50 per cent. of it would pass $^{1}/_{16}$in. It therefore presented a problem in washing, and in his own case he had to treat this slack to make it suitable for a new oven plant using modern silica brick which imposed even finer limits as regards moisture than did the older type of plant, was under construction. The problem therefore, was to bring the ash content in the washed coal down to 6 per cent. and the moisture down to 9 per cent., and preferably 8 per cent. He had carried out numerous experiments to see which type of washing plant was likely to give the best results and the conclusion arrived at was that none of the dry cleaning processes quite got to the desired point, whereas some of the wet washing processes did. Consequently, the conclusion was also arrived at that the key to success was the removal of a certain proportion of the fine dust passing 1 mm. mesh before washing and using that dust on the premises for power production or in some other way. No difficulty had been experienced in getting the moisture content in the final product below 10 per cent. and the ash percentage below 6 per cent., and by the use of de-watering screens there was no need for expensive centrifuges or filters or a thermal dryer, all of which were comparatively costly to maintain. Another problem of wet washing was the proper clarification of the washing water in circulation, but any difficulties with the River Board Inspectors could be overcome by the use of proper clarification tanks. On many occasions he had found that unsatisfactory results were due to inefficient clarification of the washing water in circulation.

Dr. R. Lessing said that his attention had been called to the statement in his previous remarks that a limit of 4 or 5 per cent. above the inherent ash was the possible limit of dry cleaning. Nothing was further from his mind. Continuing, Dr. Lessing referred to a process of coal cleaning which, he said, had not yet been made public and was dissimilar from any of those discussed so far in that it was entirely independent of the size of the coal. Thus, it was only necessary to deal with the one factor of specific gravity instead of the two factors of specific gravity and size. It was now possible to ascertain quantitatively the absolute possible maximum yield of truly clean coal from coals in which the ash and refuse were in mechanical admixture with the coal, which was the case with all small coals. It was not quite so easy in the case of large coals, and it might be found more advantageous to crush the coal where the highest possible purity was required. By this process, however, it was possible to get the ash content down to between 1 and 3 per cent. The process consisted in introducing the raw coal into a dense liquid such as a calcium chloride solution. It was not quite as simple as it appeared on the surface, because, in order to comply with commercial requirements, it was essential to remove the calcium chloride solution from the coal in such a manner that it could be recovered in its original strength without any appreciable loss. This had been found possible by removing, in the first instance, the fine portion of the coal. In order to make the process economic, however, it was necessary to carry it out in such a manner that these fines were recovered in a condition in which they could be used directly and without further grinding for powdered fuel firing or coal dust firing. That was done with such accuracy that, although the whole of this fine material was recovered, the coarse material sent to the gravity cleaning unit contained no more than a fraction of 1 per cent. of material passing 50 mesh or having a maximum diameter of ¼ mm. Discussing the question of expressing the efficiency of processes, Dr. Lessing suggested that it would be better for any cleaning process to take the calorific value of the raw coal and express the efficiency by assessing the calorific value of the marketable products obtained as a percentage of their total value.

Mr. C. W. H. Holmes said that, in dry cleaning, when coal was graded into two or possibly more sizes, results at least comparable with those of wet washing could be obtained. Two papers dealing with pneumatic separation had been presented by Mr. Raw and Major Appleyard. He disagreed with Mr. Raw fundamentally about his theory, and, speaking generally, said that the question of the improvement that could be made in the treatment of unsized coal depended primarily on the coal. Frequently, a striking improvement could be made in the county of Durham, whereas the improvement on the majority of South Yorkshire slacks would not be so great. This was associated with the ash distribution in the coal, and each case must be judged on its merits. There was no best method for washing coal, neither, probably, was there any best method for treating it dry.

Mr. R. A. Mott remarked that in the paper on froth flotation the authors suggested that instead of cleaning all coal below 10 mm., or ⅜in., by various washing processes, only that portion which was less than 3 mm., or ⅛in., should be cleaned by froth flotation. It was questionable whether any froth flotation process could clean coal of such a large maximum size as ⅛in. It used to be claimed that the maximum size was $^{1}/_{10}$in., but from figures which he had been examining it seemed that the maximum size was more often $^{1}/_{20}$in. It was well known that the advantage of the froth flotation process was that it had no lower limit of size which could be treated, but one of the great disadvantages which had prevented the wider adoption of this process was the fact that the concentrates could not easily be de-watered. That was due to the fact that the maximum size of particle which could be treated was very small. In those processes in which the air was added to the oil and coal mixture by agitation from a large fan, it seemed clear that the turbulence produced dislodged air bubbles from the larger coal particles, which, therefore, did not float. The processes which admitted compressed air at the bottom of the cell had the advantage of less mechanical disturbance, but the difficulty had been most successfully solved, in his opinion, in the vacuum flotation process associated with the name of Mr. Francis Elmore. In this process the air bubbles were produced by the operation of a vacuum, and were produced from the air dissolved in the water and from the gases occluded in the coal. The bubbles were produced without any mechanical agitation, and precautions were taken to prevent turbulence so that once the air bubbles had been attached to the large coal particles they would not be dislodged. In this way it had been found experimentally that pieces of coal of ⅛in. could be floated, and it was easy to float coal of a maximum size of ⅜in. The advantage of this was fairly obvious, because the process gave a product which could be more easily de-watered.

Dr. Tomaides (Austria) called the attention of the Conference to the fact that Dr. Fleissner, one of the authors, had died since the paper was prepared, and added that the process described in the paper had been proved most successful in the treatment of Austrian lignites. He offered to answer any questions that might be asked with regard to this paper.

Mr. G. N. A. Pitt referred to a simple pneumatic dirt-separating plant, which he had seen working at several collieries with very satisfactory results. This plant, treating 50 tons per hour, required the attention of a man and a boy; there were no moving parts subject to wear. The coal was treated from 2in. to 0 in one operation without previous sizing. In one case the ash had been brought down below 6 per cent., and the cost was exceedingly low. He agreed with Dr. Lessing that the efficiency of cleaning plants should be based on the calorific value of the fuel.

Dr. J. A. Roelofson, speaking from experience of the ordinary wet washing process, said that as regarded the removal of surplus water, there was a process which had been in use for some years, and he was surprised it had not been mentioned in any of the papers or in the discussion. He was associated with two of these plants which were of the pulsating washer type, and they dealt with a variety of coals which arrived at the coke ovens from a number of collieries 20 to 30 miles away. The coals contained from 10 to 24 per cent. of ash, which was reduced to 6 or 7 per cent. in the pulsating washer, the water being taken out without producing any slurry to speak of. The plant consisted of a series of hoppers surrounded by a trough. The coal in the first instance was crushed from 4in. to 1in., down to dust, and the whole of it was floated with the washing water into the hoppers. When the coal accumulated in the hopper, the water overflowed into a sump and was used again. The hoppers were of 120 tons capacity, and were allowed to drain through two columns of perforated metal, 2ft. in diameter and 24ft. to 25ft. in height, the height of the hoppers. The surplus water drained through these perforated columns, and came out perfectly clear at the bottom and was used over again. There were no mechanical moving parts, and the process was extremely simple. It brought down the water content of the coal to about 8 per cent.—quite a good performance. It took 36 hours for the coal in each hopper to reach this condition, and there was very little additional expense involved, as it was necessary to store three days' supply in any case, and some storage accommodation would be required for that. There were sixteen such hoppers of 120 tons capacity each. The drainage columns lasted for many years, and a good dry product was obtained for the coke ovens.

Mr. A. Grounds said that at the Bradford colliery in Manchester there was a group of spiral separators which were dry cleaning coal, but the middlings fraction obtained was re-crushed and treated on four concentrating tables, a combination of wet washing and dry cleaning, which was very efficient and dealt with the smallest coal. In the Lewis Merthyr Colliery in South Wales, both processes were also used, and the wet-washing people were anxious to co-operate with the dry-cleaning people, so that the greatest advantage could be obtained from both processes. As a matter of fact, at the present time one of the largest makers of wet washing plants was contemplating installing a dry-cleaning plant as a roughing plant preliminary to the treatment of the coal by the wet process. Therefore, the two processes were not antagonistic, but complementary to each other. Whilst in the wet process there was the difficulty of dealing with the slurry, in the dry cleaning process there was the dust problem

Mr. A. S. Brentnall said that he had had experience with one of the latest types of dry cleaning plants cleaning slack below 1¼in., in three sizes, the first to ⅜in., the second to ⅛in., and the third to $^{1}/_{64}$in. In the first the amount of shale was reduced to 1 or 2 per cent.; in the second it was down to 2 or 3 per cent.; and in the third size it was 4 or 5 per cent. There were, however, certain fluctuations in the operation of the plant which would have to be overcome. The plant was put down to make a coking slack having a maximum of 8 per cent. ash, and that result was often obtained, but owing to the fluctuations he had mentioned, this result was not always to be relied upon. As to the dust, that was aspirated. There was 10 to 15 per cent. of it sometimes and the intention was to carbonise it into a low-temperature fuel. At the present moment it was being put back. The ash content of this dust was reduced by aspiration from 14 per cent. down to 10 per cent., which bore out the remarks in some of the papers.

Storage and Handling of Solid Fuels by the User.

Under this heading four papers were discussed on Wednesday morning by Section D, under the chairmanship of Professor R. V. Wheeler. The coal-mixing plant used by the Belgian State Railways and the arrangements for fuelling the locomotives were described in a paper on "*Methods of Control, Preparation, Handling, and Storage of Coals by the National Railways of Belgium*," by Monsieur H. Chenu. The author stated in this paper that blended coal was distributed to 100 fuelling stations, and the coaling of the locomotives was done by elevators and loading towers, loading platforms and dump wagons, or cranes, according to the size of the station. Coals from 200 different sources were blended and four laboratories were engaged in coal testing, partly to control the blending and partly to determine the price. The price was increased or decreased by 2½ per cent. for every 1 per cent. of ash above or below 12½ per cent., and was decreased by 1 per cent. for every 1 per cent. of water above 5 per cent. The other papers were mostly concerned with description of coal handling plants at home and abroad.

Dr. R. Lessing, who again opened the discussion as Vice-chairman, remarked that the subject of the storage and handling of coal was entirely an engineering one. Facility in drawing samples was another important point in relation to storage. No amount of standardisation of analytical methods would avail as long as we were not in a position to draw representative samples from the consignments. The breakage of coal in transport was a serious matter. He did not think he exaggerated when he stated that the commercial side of the coal trade was based on the question of the size of coal. Personally, he had often maintained that the size which was so greatly desired by the buyer of coal, and particularly the foreign buyer, was really nothing but an implied guarantee of purity in the absence of chemical analysis. Nevertheless, it was wanted and the commercial community had to satisfy the want and try to preserve the coal in the sizes in which it was mined. The handling arrangements to-day were very faulty in that respect, and it was the fact that coal lost as much as 10 per cent. of its useful sizes by disintegration between the colliery and the port, whilst another 10 per cent. might be knocked off in the few seconds during which a coal truck was discharged into the hold of a vessel. From the commercial point of view, that was a very serious matter. None of the papers dealt with the storage, transport, and handling of powdered coal, but it would be of great use if the discussion elucidated some of the more recent experiences with the pumping of coal or transport by pneumatic means. On the Continent, and particularly in Germany, during the last three or four years, the transport of powdered brown coal or powdered semi-coke from brown coal had extended to a very remarkable degree, and the number of specially designed tank wagons for that purpose was rapidly increasing. In that country steps had been taken in that direction, and at the moment special wagons were being put into service for the conveyance of coal dust.

Mr. W. S. Edwards said that in some coke oven plants in the United States as many as six different kinds of coal were mixed together to make a charge, whilst it was common practice to mix four kinds of coal. The necessity for exactly proportioning the

different kinds of coal led to the development of the measuring coal mixer of which many examples had been working for some years in the United States by-products plants. An alternative system sometimes adopted consisted of arranging a series of bins at track level, each feeding into a shaking feeder provided with a variable stroke, by means of which a fairly close regulation of the amount of each quality of coal to be delivered was secured. The feeders discharged their coal on to a common belt conveyor leading to the pulveriser house. As to loadi ng plant for ships, the belt-conveying method was not so well known on this side of the Atlantic. Great capacities were obtained with conveyor loading, 300 to 1000 tons per hour being common, whilst the record of 3600 tons of coal in an hour was achieved by a plant at Baltimore. The type of plant was very economical as regarded labour; for instance, a ship loading plant in Spanish Morocco, using 40in. wide belts, dealt with iron ore at the rate of 1000 tons per hour from the storage bin into the ship, a 5000-ton ship being loaded in half a day by eight men.

Captain Shaw (Fuel Research Board), referring to spontaneous combustion in ships, said that some 250 ships had been examined as a result of fires being caused by spontaneous combustion. These fires could be divided into three classes. In the first place, one of the least known causes was the fact that if fresh coal was shot into a bunker in which was some coal left from the previous voyage, there was a greater tendency for spontaneous combustion owing to oxidation at the junction of the two coals. Another cause was the passage of air through the coal owing to leaky bulkheads, but the most common cause of fire was one which was so remarkable that it was surprising it could be allowed to exist. Coal was often so placed on board ship that it was definitely heated up by the heat from the boilers. Something like 60 per cent. of the fires on board ship were due to that cause.

Mr. H. W. Brooks (New York) gave a general summary of the development of the use of pulverised fuel in America in power stations and on board ship, and speaking with regard to the distribution of pulverised fuel on vessels, suggested the need for international co-operation. At the moment, he said, a type of distributor was being experimented with at the Philadelphia Navy Yard which gave considerable promise of success. Speaking of the application of powdered fuel to railways, he said that although it had been adopted rather extensively in America, it had not been a great success. During a period of from three to five years, pulverised fuel had been used on the Missouri, Kansas, and Texas Railway, on the Sante Fé Railway, and on the New York Central Railway; but up to the present it had not worked very successfully.

Power Alcohol.

Under this heading only a single paper was presented, namely, "*Alcohol for Power Purposes*," by Sir Frederic Nathan, K.B.E. The author adopted a very pessimistic tone with regard to the future of alcohol as a source of power. He reviewed the reports of the various Committees which had considered the matter, and pointed out that to replace the 750 million gallons of petrol used in Great Britain annually, about 1000 million gallons of alcohol would be required. To produce that from vegetable sources from 5 to 9 million acres of land would be necessary, according to the nature of the raw material grown. Since the total of land under grass and crops in Great Britain was only about 31 million acres, the impossibility of obtaining anything but an infinitesimal quantity of alcohol for power purposes from home-grown crops was obvious. The author considered the possibilities in other parts of the world with tropical vegetation, or waste wood, and arrived at the final conclusion that, while it might be possible to produce alcohol commercially from vegetable materials where conditions were favourable, and to meet comparatively small local requirements, liquid fuels for internal combustion engines would continue to be obtained from petroleum, but where there was no indigenous petroleum, coal must be looked to as the basic raw material of liquid fuels.

The Carbonisation Industry: Economic and General Considerations.

Section G, on Wednesday, September 26th, discussed economic and general considerations applying to the carbonisation industry.

Twelve papers were discussed together under this heading under the chairmanship of Sir David Milne-Watson. A paper on "*The Utilisation of Coke Oven Gas by the Gas Industry*," by Mr. T. P. Ridley, comprised a survey of the possibilities in that direction which exist in Great Britain. Between 1913 and 1925 the quantity of gasworks gas sold rose to 265,757 million cubic feet, an increase of 31·8 per cent. The gas made per ton of coal, the saleable coke, and the tar produced per ton had all increased very substantially, and the industry was making solid and substantial progress. The by-product coking industry in this country had, on the contrary, made little progress. The labour costs were high, and the coke produced per man per day was much less than with modern continental plants. The coke oven owners maintained that they could not bear the cost of reconstruction without some means of selling the greater quantity of gas which would be available. They even envisaged the compulsory purchase of their surplus gas by gas undertakings, an idea to which the gas industry strenuously objected. The author referred to the risk of gasworks relying on coke oven gas supplies, in view of their statutory obligations, a risk which would be reduced if the coke ovens in a district were interconnected by gas mains. He advanced other objections, and concluded that it would not be in the national interest to initiate sudden grandiose schemes for the better utilisation of coke oven gas, but that the situation should be allowed to develop gradually on economic lines.

Mr. W. Colquhoun, in a paper on "*Coke Quenching and Cooling*," made out a well-reasoned case for the dry-cooling of coke in place of the old method of water quenching. Water was, from all points of view, a bad thing for coke, injuring its physical properties and being prejudicial to the operation of blast-furnaces and cupolas. In the dry-cooling process, introduced by Messrs. Sulzer Brothers, the hot coke was put into an air-tight container, and air was blown through it by a fan. The air was in a closed circuit; it passed through a boiler, and was returned by the fan to the container. The oxygen was consumed by its first passage, and the remaining nitrogen and CO_2 transferred heat from the coke to the boiler as they circulated. The amount of coke consumed was negligible. In practice the air-cooled coke contained less breeze and much more large pieces and, most important of all, it was dry. The steam raised from the waste heat of the coke was estimated at a value of 14d. per ton of coke cooled. The dry-cooling plant at Utrecht gasworks cooled 350 tons of coke per day, and supplied all the gasworks requirements for steam and also the steam for driving a 750-kW turbo-generator. Another plant at the Homécourt Steel Works in France gave a surplus of 180 tons of steam per day, which was used to generate power for the steel works. Reference was also made to the Keilehaven plant at Rotterdam, fully described in The Engineer of May 9th, 1924. References were made, both by Mr. M. Mackenzie on "*The Economics of Coke Manufacture in Great Britain*," and by Mr. T. P. Ridley, in his paper referred to above, to the German scheme for the bulk distribution of coke oven gas, and in his general report on the papers before the Section, Mr. F. S. Townsend pointed out the differences in conditions in the two countries. The British gas industry was much larger than the German, but the coke oven industry smaller. In Germany the steel works absorbed much of the coke oven gas; in Britain only a small amount. In Germany it was proposed to use the gas for the production synthetically of sulphate of ammonia, oils, and methanol, and for the hydrogenation of coal. In Britain the practicability of such processes depended on market prices. The German scheme of long-distance gas supply had in view the object of limiting the import of foreign coal. Such a politico-economic factor as imported coal had no place in Great Britain.

Sir David Milne Watson (Governor of the Gas Light and Coke Company) presided, and in the course of his opening remarks commented upon the unanimity of opinion among the several contributors of papers in some respects, as, for instance, the desirability of placing future coking plants in proximity to iron and steel works.

Mr. R. Ray (Vice-chairman), discussing coke-quenching and cooling methods, said it was obvious from a perusal of the paper by Mr. Colquhoun that the general decision reached was that of the wet methods of quenching, remote quenching was most popular, and, he believed, rightly so. From all points of view, that method appeared to be the most successful and most efficient, and was possibly the cheapest in the long run. The dry method of cooling, as represented by the Sulzer process, was attractive, but, although it had many advantages, such as the reduction of the percentage of breeze and dust produced, there were other factors which confined its use to particular plants and particular areas. It would appear that in this country the question of capital cost was a very important factor, in view of the difficulty of finding a market, either for the steam produced or for the electricity which might also be produced. At all coking plants and at many gas works there was a superfluity of cheap fuel—coke breeze and dust—which had to be disposed of, and at present that fuel was used to raise the steam and generate electrical power required at the works. Thus, only in special circumstances would the capital for such a plant be forthcoming. It had occurred to him also that the cost of maintenance and repairs must be heavy.

Mr. George Helps pressed the claims of gas as a fuel, since it could be supplied at such a price as would enable it to take the place of all other fuels, including even coal, for all purposes. The gas he had in mind was of about 200 B.Th.U. per cubic foot, and not about 500 B.Th.U., such as was supplied by gas companies generally in this country. In that connection, he referred to the activities of his company—the Nuneaton Gas Company—and said there could be no question that gas so produced was the only fuel which could displace coal. Its production, at a price to compete with coal, as carried out by the Nuneaton Company, did not involve the use of a special process. He extended an invitation to all interested to visit the works and examine the process.

Mr. Douglas Hay discussed the effect of modern advances in fuel technology upon the coal industry. Presumably, he said, advances in fuel technology would in the long run open up new markets and increase the demand for coal, but the immediate effect was to contract the demand. The replacement of household coal by gas, coke and electricity had resulted in replacing a quality of coal, valued at, say, 25s. at the pithead, by a quality which was of little more than half that value. At the same time, greater efficiency in use resulted in a reduction of the quantity used, and there was an immediate and severe loss to the collieries. To those who objected to the collieries entering the domestic coke market, he pointed out that the collieries were suffering severely from the replacement of domestic coal by gas and coke. Another factor was that the power of barter of the large gas and electricity companies was such as to force the price of coal supplied to them to a level below the cost of production by even the most efficient collieries. It was only fair, therefore, that the gas companies should assist the mining industry in disposing of surplus coke oven gas, rather than object to the latter entering the domestic coke market. Again, if the reconstruction of the coke oven plants in this country on modern lines were to materialise, resulting in the centralisation of plants, a use must be found for the surplus gas. In the case of his own company it had been decided to build a large central plant to take slack from five collieries connected by aerial ropeway, and the determining factor in making the decision was that the company had been able to make a contract for the supply of coke oven gas to a large town. Without that contract, the scheme would never have materialised. As to the objection which had been raised, concerning the variation of the quantity of surplus gas available at the gas oven plants, he pointed out that recent contracts with gas companies provided for a reasonable variation. Modern methods of mining, he continued, were usually directed towards reducing the amount of small coal made, with the result that there was a tendency to increase cost and reduce output, and anything that fuel technology could do to increase the demand for small coal would be a help to the mining industry. Coal prices generally, except in the case of the largest sizes, were likely to increase in the future, rather than diminish, if even the more efficient collieries were to be made financially sound. Wages would tend to rise, for miners were receiving less than scavengers at the moment: depths were becoming greater and seams more difficult to work; and the miners' working day would tend to shorten. All these were factors which tended to increase the price, and he looked to advances in fuel technology to make coal worth more.

Mr. L. H. Sensicle, discussing outlets for coke oven gas, pointed to the advances made on the Continent in the direction of extracting the hydrogen from the gas and utilising it for the production of synthetic ammonia, as well as for the hydrogenation of naphthalene. Its use had been suggested, he said, for hydrogenating coal itself for the production of synthetic oil. With regard to the proposals for the supply of coke oven gas to gas companies, he pointed out that it was the manufacturing rather than the distribution side which was looked to as more likely to afford opportunities for economies, and, therefore, increased profits, so that in taking gas from coke ovens the gas companies would be giving up one of their chief sources of profit. In this connection, he said that carbonising methods were becoming more flexible. Hitherto the gas industry had been forced to use less economic carbonising units because it had had to deal with the fluctuations of demand at different seasons of the year. The modern compound regenerative oven, however, could be kept working on a steady throughput of coal, and fluctuating demands for gas could be met by burning some of the gas under the ovens, if necessary, when the output was beyond the demand. The gas industry had its statutory obligations to fulfil; it had to supply gas all the year round in accordance with the demand, and at a certain pressure, and if it failed it was penalised. It ought to be possible, by legislation, to transfer that obligation from the gas company to the coke oven company, and that would redound to the public good, in that uneconomic plant would not have to be kept as a standby, and the wages of standby gangs of workmen would not have to be paid.

The economics of the gas and coke oven industries were discussed by Mr. Thomas Hardie, chief engineer to the Gas Light and Coke Company, who said that the metallurgical coke industry appeared to be turning longing eyes to the markets of the sister industry in order to meet the shortages and disappointments of its own. The markets for the main products of the two industries had been so different in the past that, except in the case of the less important by-products, no approach to joint marketing had been made, nor was it necessary. As to the proposals made for the domestic utilisation of surplus coke oven gas, he said the gas industry was quite prepared to consider such proposals sympathetically, but it did wish to be satisfied, outside the question of price, that its consumers would not suffer either in the security or in the efficiency of the supply, and that the national interests of the community would not be affected deleteriously. From a broad view, it was clear that gas plant with equal-priced coals would produce gas more cheaply than coke oven plant, and fancy comparisons with the selling prices

of domestic gas, or even with prices of gas into holder, unless proper allowances were made for the varying load the gas manufacturer had to meet, for the increased maintenance due to the necessity for replacing out-of-date plant, and for the condition of wages, welfare of employees, and other advantages gained by many years of arduous development, were unreliable. The installation of coke ovens had been considered by all the largest gas undertakings, but only in one case were ovens erected. Those ovens were built many years ago, and were now offered for sale. Schemes which were being started in Germany for the supply of coke oven gas were often quoted without mention of the fact that by far the greater proportion of the gas was, or would be, absorbed by steel works. In a paper before another section of the Conference it was stated that 62 per cent. of all the surplus coke oven gas in America was used in steel works. The erection of coke ovens as a portion of iron and steel works had been urged many times, and wherever that co-ordination had taken place, success appeared to have attended coke oven operations. The necessity for larger steel works, as well as more concentrated coke oven plants, had also been mentioned. There was one combined works in the United States which carbonised 32,000 tons of coal per day, the whole of its production of coke and gas being absorbed in the metallurgical processes. Did not that indicate to the coke oven industry a way to success? It suggested closing down inefficient plants and building a large combined one which would permit the industry to compete successfully in its proper markets. It appeared very desirable to give the most serious consideration to that combination of coke ovens and steel works before extensive reconstructions of oven plant situated at collieries was undertaken on the strength of a market for the gas produced and in the hope of a domestic market for coke. There would be no increase in those markets because they were supplied from coke oven sources instead of from gasworks. The entry of coke oven manufacturers into the domestic coke markets would not result in an additional demand, but would simply replace a demand which was being met satisfactorily by gas undertakings, which demand had been developed by the gas industry's efforts to improve the suitability of coke by grading, and to educate the public to its advantages. Furthermore, prices would be forced down to an unremunerative figure for all parties. While special cases undoubtedly existed in certain parts of the country favourable at present to the supply of gas to gasworks from coke oven plants, it was impossible, in his opinion, that the work of gas manufacture and domestic coke production could be transferred, to the national advantage, on a scale which would provide a solution of the difficulties of the furnace coke manufacturer or of the coal industry.

Mr. W. M. Carr (Stretford), who also discussed coke oven gas supply to gasworks, pointed out that the load factor of a particular town's supply had much to do with the question of whether or not coke oven gas could be made available. If there were a good load factor and a considerable industrial load, and the demand was spread fairly evenly over the twenty-four hours, then mains for the long-distance transmission of gas from coke ovens, and provisions for storage at point of user, would be small, so that the capital cost would be small, and the supply of coke oven gas would possibly prove economical. In many cases, however, the load factor and other economic considerations were not such as would permit of the supply of coke oven gas, however much the gas undertakers might desire to obtain such a supply, and in that connection he pointed out that there were no great differences between town gas suppliers and colliery people in this country. Another factor to be considered was the obligation of gas undertakers to maintain constancy of calorific value of the gas supplied to their consumers, and he had heard that there were considerable variations in coke oven gas in that respect.

The increase of the rating assessments of gas companies as the result of obtaining a supply of coke oven gas was mentioned by Mr. J. E. Lister Cooper, who referred to cases in which the rating assessment on gas undertakings which had commenced to take coke oven gas supplies had been more than doubled, because they were no longer entitled to certain allowances with respect to tenants' capital. One small undertaking, with an output of 74 million cubic feet per annum, had a rating assessment of under £1200, but when it began to take a supply of coke oven gas the assessment was increased to £4500. On appeal it was reduced to £1950. The amount paid in rates by a gas undertaking was generally about 2¼d. or 3d. per 1000 cubic feet, and an increase of a further 3d. per 1000 cubic feet was an important consideration.

Mr. John Roberts expressed regret that there should be any feeling of antagonism between sister industries, and said that, rather than that they should attack each other, he would prefer to see them combining to attack the common enemy—the domestic grate. He believed the coke oven and gas industries could make a fuel which would be much superior to any domestic coal being used in open grates to-day—a fuel which would be of universal application so far as the domestic grates were concerned. At present, 35 million tons of raw coal was being burned annually in domestic grates.

Dr. E. W. Smith denied that there was any attack by one industry upon the other. He had read the papers submitted to the Section and had followed the discussion, but could see no sign of an attack. There was quite a proper "safety-first" attitude on the part of the gas industry, and quite a proper acquisitive attitude on the part of the coke oven industry. He understood that a committee was to be appointed by the industries concerned, to go into the matter, so that there was no point in discussing the matter further.

The Chairman endorsed Dr. Smith's view, and said that, so far from there being any feeling of animosity, the two industries had decided to appoint a joint committee to discuss the questions arising. That did not look like animosity, but rather a desire to understand each other's position, and if possible to help each other in the solution of the problems which had presented themselves. There was a desire on the part of the coke oven industry to sell gas to the gas industry, and a natural "shyness" on the part of the gas industry, until it knew its position, with regard to accepting the suggestions made to it without a good deal of inquiry. Referring to the suggestion of the National Fuel and Power Committee that there should be an investigation into this question in an area in the centre of England, Sir David pointed out that, in signing the recommendation, he was merely approving the suggestion that an investigation should be held into the facts, and it must not be assumed that, because he was a signatory, he was approving of any particular proposals. It was not known how much coke oven gas was really surplus, how much would be surplus in the future, when the needs of the iron and steel industry were met, or whether the distribution of surplus coke oven gas by the gas undertakings would render the public gas supply cheaper or dearer. Hence, such an investigation as had been suggested was most desirable.

The Composition, Classification, Preparation, Storage, and Handling of Gaseous Fuels and of the Products of the Carbonisation Industry.

Seventeen papers collected under the above comprehensive title were discussed together on Thursday morning, under the chairmanship of Mr. J. Terrace. Three of the papers dealt with fuel or gas analysis, Professor Bunte, in a contribution, entitled "*New Methods of Fuel Analysis*," considering particularly the determination of the properties of fuels with which the carbonisation industries were concerned. He supported the xylol method of determining moisture in coal, and urged the importance of determining the reactivity of carbonised fuels, on which depended the suitability of cokes for gas producers, blast-furnaces, &c. The question of "reactivity" was also touched upon by Professor J. W. Cobb, in a paper on "*Gas Manufacture*." He pointed out that low-temperature carbonisation processes were not the only means of producing solid fuels of high reactivity, which therefore would burn freely, but that high-temperature coke could be made much more reactive by the addition to the coal of sodium carbonate, lime and oxide of iron. The use of such cokes had, however, not yet reached the commercial stage. Work on the reactivity of coke, now being carried out in Japan, was described by Mr. Y. Oshima, in a paper on "*Coal Carbonisation in Japan*." In a contribution on "*The Purification of Coal Gas*," Mr. Charles Cooper gave a very comprehensive survey of all the processes in ordinary use. He considered that the Cottrell method of electrical precipitation gave good results on the extraction of tar, though the plant was three times as costly as the usual apparatus. As regarded the drying of gas previous to its distribution, he thought the method of using a solution of calcium chloride was the most economical one. It was simple to carry out, and cost less than ¼d. per 1000ft. of gas treated. In a paper, entitled "*Coke Oven Practice and Developments in Bulk Carbonisation*," Mr. W. H. Blauvelt showed how the operation of a coke oven plant and the yield of by-products had been improved by the spraying of the hot gas in the collecting main, with hot liquor at 80 deg. Cent. or so. That caused the tars to be precipitated and eliminated troubles from pitch and consequent cleaning of pipes. The best results were obtained by the spraying of about 45 gallons of liquor per hour per ton of coal coked per day. Monsieur A. Dessemond contributed a paper, entitled "*The Gasification of Fuels by Liquid Slag Producers*." In order to use very low-grade fuels, a gas producer was constructed on the lines of a small blast-furnace. It was fed with shale or refuse, along with a certain quantity of coke breeze, scrap iron and limestone. The producer was 2·5 m. diameter by 11·5 m. high, and handled 100 to 150 tons of material per day, producing about 200,000 cubic metres of gas of about 1200 calories per cubic metre. The blast was preheated in metal recuperators fired with producer gas. The products available for sale were 60 tons of ingots and 40 tons of slag per day, the slag being used for cement manufacture. The gas after cleaning costs and washing was used for heating purposes.

Mr. E. V. Evans (joint manager, South Metropolitan Gas Company, and Vice-Chairman of the Section), who opened the discussion, briefly reviewed the various papers presented. With regard to a paper by Dr. J. G. King on the production of solid smokeless domestic fuel, he said Dr. King had forecast indirectly that the blending of coal was essential if it were desired to produce a coke whose characteristics might be controlled. Professor Cobb had questioned whether coke might not be made so reactive by the addition of inorganic compounds that the necessity for low-temperature carbonisation for the production of highly reactive semi-coke would disappear. Commenting on the paper by Monsieur Dessemond, of France, on the gasification of fuels by liquid slag producers, he pointed out that one had to consider first the ease of working the process and whether the cement, which was the by-product of the process, could be disposed of effectively. It was stated in the paper that the plant was making 60 tons of cement per day, which was comparable in qualities with the best Portland cement. This was an important factor, for it was probable that in building construction to-day the main costs were those of labour and of transport of materials, so that it would pay to use none but the very best of cements.

Mr. John Roberts, dealing with the blending of coals for the production of coke suitable for domestic purposes, referred to some large-scale experiments with which he had been concerned, with a view to improving the quality of gas coke and furnace coke, to render it suitable for use in the open grate, and he had been surprised at the simplicity of the method, once the proper blend was obtained. The blending, however, must be given very careful consideration. In experiments carried out at Ramsgate in the Woodall-Duckham intermittent vertical retort the temperatures employed for gas making were not disturbed in any way. The blend, which was carefully prepared, was put into the retort and instead of being heated for twelve hours, it was heated for eight hours, and the fuel obtained was greatly superior as a domestic fuel to that produced normally within the same retorts. If domestic fuel only was required, or if it was the chief product, it was not really necessary to work at a low temperature. At the same time, the high-temperature system of manufacturing semi-coke was only a partial solution of the domestic fuel problem, and he could conceive of several low-temperature processes being successful. Mr. W. H. Blauvelt, of the United States, one of the authors of the papers before the meeting, had stated that he had obtained a much improved coke as the result of blending. He had said that one of the characteristics of recent coke oven operation was the production of a free-burning coke having a well-developed cell structure, more reactive to the oxygen of the blast than was formerly thought practicable. In that connection Mr. Roberts drew attention to the possibility of making, at a lower carbonising temperature, a fuel more reactive in the blast-furnace than the ordinary blast-furnace coke, and he suggested that an investigation into the most desirable temperature at which furnace coke should be made would be valuable.

Dr. R. W. Griffiths (Gas Light and Coke Company) dealt with some experiments carried out by his company in connection with the manufacture of gas from liquid fuels, having in view the enrichment of water gas. About thirty different oils were analysed and examined with respect to their behaviour on cracking under standard conditions. Yields varying from 0·5 to 1·45 therms per gallon were obtained, and comparison of the figures with those of analysis showed that hydrocarbons having a cyclic structure were far less valuable than those built up with open chains. So that although the cyclic bodies might well give rise to some gas, yet a qualitative valuation of an oil could be made by regarding all cyclic constituents as useless. It was hoped shortly to publish an account of the whole work.

In amplification of his paper on calorimetry by the explosion method, Dr. H. A. Löffler, of Austria, pointed out that the field of application of the explosion calorimeter was different from that of the usual calorimeter. The explosion calorimeter was transportable, and could be applied for tests at different stages of the production of gas. With regard to the accuracy of the instrument, he pointed out that it was essential that a proper ratio of air to gas be obtained in the explosion chamber, otherwise no explosion would take place or incomplete combustion would occur.

Mr. L. H. Sensicle, dealing with the production of ammonium sulphate, said that it appeared that Mr. Parrish was very doubtful as to the possibilities of the direct recovery method in gasworks. He pointed out that the initial difficulties of the direct process had been overcome, and that the process had worked satisfactorily and without interruption over a period of years in many places.

Gas production by the cracking process was discussed by Dr. G. Egloff (U.S.A.), who said that in the United States in 1927 over 200 thousand million cubic feet of gas was produced by this process at a temperature of approximately 475 deg. Cent. A good deal of it was used by the gas companies for enriching water gas. In some plants the cracked gas was re-cracked at a very high temperature, so as to increase the volume of the initial gas and reduce its B.Th.U. content from approximately 1200 to about 550 per cubic foot, and the use of cracked gas had resulted in a reduction of the quantity of gas oil used.

Mr. E. Kilburn Scott criticised coke oven undertakings for wasting gas instead of stripping the hydrogen from it and using the hydrogen for the pro-

duction of synthetic ammonia. In that connection he mentioned one works at which gas was being burned to waste at the rate of 2½ million cubic feet per twenty-four hours, and said he had put forward a proposal to make synthetic ammonia. When the hydrogen was stripped off, about 40 per cent. of the original quantity of gas produced remained, and was sufficient to provide the power necessary to carry on the processes at the works. Furthermore, the calorific value of the remaining gas was higher than that of the original gas, owing to the low calorific value of the hydrogen. People had no business to waste the assets of the country by throwing away large quantities of gas or by failing to utilise all the assets in the coal. There was a big synthetic ammonia plant at Bellingham, but it would not do to produce all our fixed nitrogen in one place. It was important, therefore, that some of the coke oven people should make synthetic ammonia. He criticised the suggestion to transmit coke oven gas to towns considerable distances from the plants, and said it would sometimes be found that the cost of the gas delivered would be greater than the cost of manufacturing gas at the gasworks in the town.

Monsieur J. E. Osterrieth (Belgium) emphasised the advantages of synthetic ammonia over the by-product ammonia, from the points of view of purity, colour and ease of neutralisation, which latter facilitated storage and enabled the synthetic ammonia to be exported.

A preheating process, to enable coal to be carbonised rapidly at a high temperature, with the production of a highly reactive coke, as an alternative to coal blending, was referred to by Mr. Roy Illingworth. The process involved the heating of the coal at a temperature generally below 400 deg. for quite a short time, in order to eliminate the less stable compounds, and the carbonisation of the resultant product in ordinary ovens to produce a coke of high reactivity. The preheating might save about 30 per cent. in the time of carbonisation, owing to the fact that the product charged into the oven was drier than ordinary coal. The production of a highly reactive coke, he said, which might be of value for ordinary domestic purposes, could be attained by blending, by preheating, or by other methods, and the question as to which process was adopted was purely a matter of economics.

Mr. Siderfin (Gas Light and Coke Company) discussed experiments carried out by the Gas Light and Coke Company, and said the results gave the impression that the rate of carbonisation was influenced to a much greater degree by the size of fuel carbonised than by blending.

Dr. F. S. Sinnatt described experiments in which single particles of coal were carbonised. The experiments indicated that there was some critical size, to which all coals must be ground in order to obtain the greatest amount of coke.

Dr. E. W. Smith emphasised the need for paying more attention to the production of apparatus suitable for burning coke, and pointed out in that connection that when central heating systems were introduced into buildings in this country, the boilers installed were almost invariably too small for burning coke or special coalites, though they were satisfactory for burning anthracite. A large quantity of coke was already being used with every satisfaction for domestic purposes, subject to the stoves being big enough, and it would be a pity if the market for the big bulk of it were spoiled by the defects of the stoves or grates.

Mr. J. G. King agreed as to the necessity of improving grate manufacture in order to burn efficiently the smokeless fuels available. He had seen several new grates of the open type, and felt sure that before very long there would be quite a considerable increase in the amount of gas coke consumed in this type of grate.

Mr. P. Parrish, replying to Mr. Kilburn Scott's advocacy of the use of the hydrogen stripped from coke oven gas for the production of synthetic ammonia, asked why Mr. Scott had not directed attention to the utilisation of the ammonia which was already available, at a price of only £3 18s. per ton. If we were to realise for by-product ammonia what it really merited, he concluded, it was necessary to centralise works and develop mass production.

Utilisation of Fuels for Steam Generation and the Production of Electricity.

On Friday morning, September 28th, Sir Charles Parsons presided over one of the largest meetings of the Conference assembled to discuss no less than fourteen papers, which, although grouped together under the above title, covered an even wider range of subjects than the title would justify. The extent of the field traversed may be indicated by the inclusion of a paper on "*Researches with High-pressure Steam*," by Dr. Jaroslaw Havlicek, and another on "*The Application of the Air-cooled Condenser to Locomotives*," by Mr. M. T. Lindhagen. In the former paper Dr. Havlicek described the investigations being carried out in Czechoslovakia for the determination of the properties of steam at very high pressures and temperatures. The apparatus, which consisted of a boiler, a throttling valve, and a condenser, was erected in the electric power station of the Witkovice coal mines in Moravia. The boiler was a spiral coil of steel tube forming the short-circuited secondary winding of a transformer, and heated by the electric energy supplied to the primary winding. Water was forced into this tube by a feed pump, and the heat contents of the steam produced were deduced from (*a*) the heat supplied, (*b*) the Joule-Thomson throttling effect, and (*c*) the condensation of the steam. Up to the present tests had been made with steam at 100, 202, and 253 atmospheres (1422 lb., 2870 lb., and 3600 lb. per square inch), with temperatures up to more than 500 deg. Cent. The general result appeared to be that total heats at temperatures above 400 deg. Cent. were found to be slightly lower than given by Mollier. The work of Callendar was not mentioned by the author.

In Mr. Lindhagen's paper, the author described the form of condenser employed on the Ljungström turbine locomotives and gave calculations and details of its performance. The condenser elements consisted of thin flattened copper tubes, provided with straight fins solid with the metal and crossing the elements at an angle. The elements were placed side by side, separated only by the fins, which provided "criss-cross" channels for the cooling air. In the paper the best width of elements and slope of fins were discussed. Curves were given showing the total steam consumption, the consumption per horse-power hour, and the percentage of steam consumed by the turbine driving the condenser fans, in proportion to the output of the main turbine. As an example, for 50 deg. Cent. temperature difference between steam and air, 40 deg. Cent. air temperature and 2000 H.P., the steam consumption would be 6·3 kilos. per horse-power hour, the total steam used being 3·5 kilos. per second. To condense that total quantity of steam 10 per cent. of the boiler output was used in the fan turbine. If the air temperature was increased to 50 deg. Cent., the maximum steam supplied by the boiler being limited to 3·5 kilos. per second, the maximum output of the locomotive would be 1850 H.P., a reduction of only 7·5 per cent. The table below gives the official tests of the Ljungström locomotive now running on the Argentine railways :—

Journey	1	2	3	4
Date, 1926 ..	Mar. 23–25	June 13–15	Sept. 17–19	Nov. 23–25
Mean air temp.:				
Sun	35° C.	28° C.	30° C.	37° C.
Shade	27° C.	19° C.	18° C.	30° C.
Vacuum per cent				
Maximum ..	68·7	78·2	72·7	68·6
Minimum ..	62	68·7	64·6	61·9
Fuel consumpt., litres/1000 ton kilom.	10·37	11·92	8·5	10·8
Water consumpt litres/hour ..	200	210	190	210
Average train weight, tons..	920	920	1600	1320

The runs were made between Tucuman and Santa Fé, a distance of 797 kilomts., or 500 miles, in each case.

The author also gave a diagram showing that the fuel consumption was a linear function of the weight of the train, the law being analagous to that found by Willans for the steam consumption of engines, and by Parsons for the coal consumption of power stations.

A paper by Stanislaw Felsz on "*The Burning of Polish Coal on Locomotives*," contained a discussion of the behaviour of Polish coal from the Dabrowa basin, when used as a fuel for locomotives. To determine the characteristics of this fuel, and to enable it to be compared with Russian (Donetz) coal and Yorkshire and Newcastle coals, more than eighty test runs were carried out on a length of track of 125 kilomts., with varying gradients. In about sixty of these runs there was an arch in the fire-box, and all kinds of coal were used. The other twenty runs were made without an arch, using two kinds of coal only. The results of the tests showed that the best efficiency of the boiler, when burning Dabrowa coal, could be represented by the equation—

$$M^{o}_{o} = 81 - 6{\cdot}3\ K\ b,$$

in which K b represents the quantity of coal burnt per square metre of grate area, expressed in millions of calories. Dabrowa coal varied from 6000 to 7600 calories per kilogramme, but taking a "standard" coal of 6300 calories, the simplest equation for the best boiler efficiency reduced to—

$$\eta^{o}_{o} = 80 - 0{\cdot}04\ b_s,$$

in which b_s represented the kilogrammes of standard coal used per unit of grate area. The author further discussed the question of arches, the most suitable quantity of excess air, slagging, grates, fire-box dimensions and spark emission. With Dabrowa coal, for equal rates of combustion, the results were better than with Russian coal. It was only under medium loads and with an arch that the excess air had its best value; at low loads it was too great and at high loads too little for the greatest economy. The formula given above showed that the critical rate of firing was 6·43 million of calories, which corresponded to just over 1000 kilos. of Dabrowa coal per square metre per hour. At a critical efficiency of 40·5 per cent., that corresponded to more than 4000 kilos. of steam per square metre of grate. It might be assumed that such a large amount of coal per unit of grate area was temporarily reached when using Polish coal from the Saturn mine, at an average K b value of 4·4 million calories. Arches were now used in all locomotives without exception, experiments having shown that arches 1·2 m. to 1·35 m. long were undeniably useful with low rates of combustion. In suburban passenger work, with a firing rate of 250 kilos. per square metre per hour, an arch 1·2 m. long gave a saving of approximately 5 per cent., as compared with a 0·6 m. arch. On shunting engines a 1·35 m. arch showed a saving from 8 to 11 per cent. when burning lumps and nut; when burning mixture, the saving was only 4 per cent. Arches in all cases reduced the leakages of boiler tubes, but their main advantage consisted in reducing the loss due to carbon monoxide.

A second paper by the same author, entitled "*Methods Employed by the Polish Railways in Order to Promote Fuel Economy*," described the influence of properly trained firemen and bonuses for coal saving upon the fuel consumption of the Polish State Railways. The firemen were selected from metallurgical workmen, with at least a secondary school education, and after completing a locomotive apprenticeship, and a finishing course, they were called assistant engine drivers, and went on to the footplate, eventually rising to auxiliary drivers, and then to qualified drivers. On the Polish railways each working locomotive was served by two permanent crews who were given the option of mutual selection. On twenty-four hour shunting work there were three permanent crews. The coal was estimated on a common basis for all crews serving the engine. The premiums for economy were estimated per engine and distributed among the crews in proportion to the engine-kilometres run by each. The rates were so adjusted that men welcomed the heaviest train loads. The results of the premium system were shown from the statistics of one of the railway districts which handled about 30 per cent. of all traffic in the country. The country was flat, and the daily traffic amounted to thirty-two trains per kilometre. In the year 1921 the coal consumption amounted to 100 kilos. per 1000 ton-kilometres. At an average load of 345 tons per engine-kilometre, the consumption was 34·5 kilos. per engine-kilometre. The application of the premium system in 1924 brought the coal consumption down to 75 kilos. per 1000 ton kilometre, and the consumption per engine-kilometre to 27·5 kilos. The load per engine-kilometre increased only to 367 tons. In 1925 the premium system was improved, larger engines were put into service and other changes made. The result was that for 1926 and 1927 the consumption of standard coal (6300 calories) decreased from 75 kilos. to 49·5 kilos. per 1000 ton-kilometres. The consumption per engine kilometre decreased only from 27·5 kilos. to 24·5 kilos. in the same time. In conclusion, the author suggested that railway statistics should show the average calorific value of the coal consumed, and also the average gross train loads per estimated engine-kilometre. Alternatively, the consumption of coal of standard quality per 1000 ton-kilometres gross should be given.

To all people interested in power station work or low-temperature carbonisation processes, the paper on "*The Economic Utilisation of Fuel in the Production of Electricity*," by Mr. R. P. Sloan, C.B.E., will rank as the most important of those put before the meeting. After showing the very small proportion which the cost of coal bore to the total cost of supplying electricity to small consumers, the author devoted practically the whole of a long paper to a description of the low-temperature distillation plant put down by the Newcastle-on-Tyne Electric Supply Company at their Dunston power station. This plant had shown that from 1 ton of coal costing, say, 12s., and containing, say, 11,500 B.Th.U. per lb., derivatives could be obtained, by distillation, the value of which was 10s. 6d., or 87 per cent. of the value of the raw coal. The semi-coke which remained has a cash value on a heat basis of 76 per cent. of the raw coal, so that by distillation before combustion a 63 per cent. increase in cash value was obtained. The results of the Dunston process are given in the following table:—

Coal Distillation Plant at Dunston Power Station.
Value of Derivatives from one ton (2240 lbs.) of Coal.

		s.	d.
(*a*) From distillation of volatile constituents—			
1·0 gallon of motor spirit at 1s. 2d. per gallon ..		1	2·00
1·0 ,, white spirit at 1s. 1d. per gallon ..		1	1·00
1·43 ,, crude paraffin at 3½d. per gallon ..		0	5·36
6·88 ,, creosote at 8½d. per gallon		4	8·76
5·00 ,, pitch at 5·38d. per gallon		2	2·00
0·507 ,, cresylic acid at 1s. 8d. per gallon ..		0	10·14
		10	6·16
(*b*) Semi-coke and gas, having a calorific value equal to 0·76 tons of raw coal at 12s. per ton		9	1·44
		19	7·6

N.B.—Gallon = volume of 10 lb. water. Prices given are those ruling during first quarter of present year.

The combination of coal distilling and steam-raising plant involved two processes; first, the careful heating of the coal to drive off the distillate, and, secondly, the delivery of the residue to the boiler furnaces. To avoid expense in handling the semi-coke, it was decided to build the distillation plant as an integral part of the station. The plant was in the boiler-house and the coke went directly from the retorts to the furnaces. There were four retorts and four boilers. The coal was screened, the fines being pulverised, and fired in one of the boilers, the screened coal going to the retorts. The boiler plant operating in conjunction with the retorts consisted of three Babcock and Wilcox coke fuel boilers, two of which were built together, and had a combined evaporative capacity of 18,000 lb. per hour, while the other had a capacity

of 30,000 lb. per hour. Each boiler forming the 18,000 lb. unit had its own retort capable of distilling 20 tons of coal per day. The 30,000 lb. boiler had two retorts with a combined capacity of 20 tons per day. The complete plant was therefore capable of distilling about 100 tons of coal per day, and the resultant coke was available for three boilers. The fourth, or pulverised fuel boiler, had a capacity of 30,000 lb. of steam per hour, and took the peak loads, thus enabling the throughput of the retorts to be kept constant. The condensing and gas-washing plant was outside the boiler-house, as were also the spirit recovery and tar-refining plants.

The screened coal was fed to preheaters, which resembled chain grate stokers, the objects being to prevent the sticking of the charge in the retorts and to conserve heat. The passage through the preheaters took fifteen minutes, the coal being then fed continuously to the retort by a screw. A constant level was automatically maintained in the retort. The distilling medium consisted of a mixture of steam and the products of combustion from the burning of coke oven gas in a small cumbustion chamber under each retort. Steam at approximately atmospheric pressure, obtained partly by the quenching of coke, was used to regulate the temperature and composition of the distilling gases. Distillation required about three hours, the coal being then extracted continuously by toothed rollers forming the bottom of the retort. The distilling gases and the volatile constituents were drawn from the retorts by an exhauster, filtered and condensed. The tar was pumped to storage tanks and the uncondensible gas washed with oil coming from the spirit-recovery plant and conveyed to burners at the back of the boiler. The calorific value as fired was about 80 B.Th.U. per cubic foot. The spirit recovery and refining plant were on standard lines. The total cost of operation and maintenance amounted to 4s. 8d. per ton of coal distilled, as the average of experience over three years' working. The plant was operated by three shifts of men per day, the total staff comprising twenty-one men. A plant of four times the capacity could be operated with an increase of only 40 per cent. in labour. As regarded the disposal of the products, the coke and surplus gas were burnt. Other products had found a ready market locally, the motor spirit being used on a wide range of motor vehicles with every success. The author closed with a reference to the experiments which the Fuel Research Board have been conducting for some years, and asked for the speedy and frank publication of all experimental results, whether successful or not.

After Dr. Gerald Stoney had read the general report on the various papers, the discussion was opened by Mr. R. P. Sloan, who mentioned that experimental work in connetcion with low-temperature carbonisation had been started ten years ago by the Newcastle Electric Supply Company, and Messrs. Babcock and Wilcox had taken an active interest in the work. The speaker could not agree with, nor be held responsible for, the extravagant statements of the daily Press, but he was optimistic enough to believe that the time and money spent at Dunston had had the result of putting engineers well on the way to a solution of the low-temperature carbonisation problem. Mr. Sloan spoke also of the growing nuisance of grit and smoke in the atmosphere, and hinted that a day might come when the open domestic grates would be illegal. Dr. Havlicek, who spoke next, outlined the nature of the experiments described in his paper, and considered his determinations of the properties of high-pressure steam were likely to be more accurate than the figures deduced by previous workers from a knowledge of the properties of low pressure steam.

Professor D. Hay remarked that the price of coals had to-day been forced by competition below the cost of production. Of the 3000 collieries in Great Britain, about 1000 of the smaller ones had gone out of business, and even the larger ones could not make both ends meet. Similar depression in the trade existed on the Continent. Modern methods of fuel economy had injured the colliery interests, which were selling less coal, and that at a lower price. Many contracts for the supply to power stations were taken at less than half the cost of production. The demands of users were changing from large good coal to small cheap coal. Wages could not remain at their present low level, and hours of working would be lessened. He thought a rise in the price of coal likely in the near future, and that it would soon be controlled by an international combination. At present 20 million tons of low grade fuel were thrown away or left in the pits annually after bearing mining costs. This was exclusive of the 15 million tons used by the collieries themselves. Collieries now had one million kW of steam raising plant, and could produce their own power at 0·24d. per kW, a price with which no supply company could compete. Typical collieries saved from £5000 to £30,000 a year by generating their own power, and they could well set-up as electricity producers, though they did not wish to do so.

Mr. W. N. Erdos then discussed the combustion on mechanical stokers, with reference to the proportions of CO, CO^2, and O^2 found experimentally in different parts of the furnace.

Mr. I. V. Robinson (British Electrical and Allied Manufacturers' Association) remarked that he wished to further the cause of international agreement with regard to the properties of steam. Professor Callendar had done much work on the subject before the war put to a stop to it. Then in 1921 the Americans under Mr. George Orrok had tackled the matter seriously, and had appointed three committees to investigate various properties of steam. As the whole of the ground was not covered, we on this side offered to take up further investigations. As it would have been deplorable to have different tables in America and England, Mr. Orrok and the speaker had agreed that neither country should publish tables before the facts were accepted by both. Messrs. Knoblauch and Jakob, had also agreed on behalf of Germany. Mr. Robinson had been unaware of Dr. Havlicek's work, and extended a cordial invitation to him to co-operate, so that the investigators in the four countries could put before the world tables which would be accepted by all.

Mr. Hellemans advocated the interconnection of all industrial power plants with electricity supply systems, so that the surplus energy of individual manufactures could be organised for the benefit of all. Mr. Forssblad referred to the development of high-pressure oil-fired boilers in Sweden, in which the air for combustion was heated to 600 deg. Cent. The superheater tubes and parts of the air heater were of stainless steel. A boiler with a heating surface of 2380 square feet could produce 88,000 lb. of steam per hour, with an efficiency of 75 per cent. at three-quarters load. Full pressure could be reached from cold conditions in eleven minutes only, and the space was only half that occupied by an ordinary boiler of equipvalent output.

Mr. W. M. Selvey, referring to the dust problem, said that although apparatus might be available for extracting dust and grit from flue gases, the discharge of such vast quantities of gases at one point was becoming an important matter with large modern plants. He thought we should have to increase both the number and the height of stacks in the future. Mr. Selvey expressed appreciation of the Dunston low-temperature carbonisation process. It would be noticed that the Dunston plant did not rely on the sale of ammonium sulphate, nor on coke, nor on gas. The plant also used a non-coking coal, of which the supplies were much greater than of coking coals. The by-products were worked up, and it would be noticed that every industrial organisation which had successfully stood the stress of the last few years was of the "public utility" type, in which finished products were delivered to the consumer.

Mr. Geo. Orrok mentioned that two-thirds of the power in the United States were derived from coal and gas and oil-power were negligible except for the automobile industry. So efficient was power-generation now, that the average consumption of coal in all the central stations of the States, with an annual output of 90,000 million kWH per annum, was only 1·8 lb. per kWH. This covered all classes of coal from 8000 to 14,000 B.Th.U.'s per pound. By-product recovery was solely a question of economics. There were no more B.Th.U. to be gained from coal by distilling it. In the United States at present there was no market for the by-products. As to smoke, dust and ashes, this was a big problem for a company burning ten million tons of coal a year. His company, however, had a clean bill of health from the authorities, where mechanical stokers were employed and efficient grit collectors catching 95 per cent. of the ash provided. With powdered coal it was another question. He had yet to hear of any plant catching day in an day out, 80 per cent. of the analysed ash, though test figures of 90 per cent. could be produced. There were indeed some users of powdered coal who claimed to have no ash! With regard to the properties of steam, the American Committee had spent 100,000 dollars in eight years in investigations, and it was hoped that final results would be available by December of this year.

Mr. F. D. Napier considered that the burning of fuel in a pulverised form was only justified when there were large quantities of coal available, which could not be burnt otherwise. This country had been the first to produce a really effective low-temperature carbonising plant, and he was able to state that not once in twelve months had there been any involuntary stoppage of the Dunston plant. It was no more difficult to operate than an ordinary boiler, being practically fool-proof. The coal used—Northumberland rough slack—was screened to avoid dust troubles in the retorts, but the plant had been run many days without screening at all, a practice which conserved a considerable quantity of oil otherwise burnt. Mr. C. P. Sloan had been conservative in his statements as to the performance of the plant, from which a sizeable domestic coke could be obtained if desired. The very small consumption of clean steam in the process should be noted.

Mr. A. Spyer said that when Messrs. Babcock and Wilcox were asked if they could supply plant for a costly experiment, the national importance of the work appealed largely to the directors. After three years of working the Dunston plant had shown itself a practical success, and dealing, as it did with 100 tons of coal a day, it could not be called a toy. He wished to urge upon engineers the importance of standardisation of pressures and temperatures in power stations, as the extraordinary diversity of practice was one of the reasons for the high cost of boiler plant. Mr. Spyer further remarked that pulverised fuel firing was suffering from the excessive claims of its friends, and a reaction in favour of mechanical stoking was likely. His firm had made experiments with water-cooled furnaces, and valuable data had been obtained as to the part played by radiation on heat transmission. He, also, considered the statements of Mr. Sloan with regard to Dunston to be conservative.

Mr. H. Van Hettinga Tromp pointed our that as a coal-producing and non-oil producing country, Great Britain would be well advised to examine every possibility of using coal for her navy and merchant marine, and he thought that the progress made in the Dutch East Indies might be studied with advantage. Signor Forte drew attention to the various ways of promoting fuel economy, and instanced the electrification of railways in Italy. In that country 1150 kiloms. of lines were already electrified, and a further 550 kiloms. nearly transformed.

Professor C. I. Finch thought the day was far distant when the open domestic fire would be abolished, as hinted at by Mr. Sloan.

Mr. George Helps made an emphatic speech in favour of gaseous fuel, claiming that in certain instances a gas-fired Lancashire boiler produced steam more cheaply than a coal fired one. He thought that the Dunston plant would be still further improved by the gasification of the coke produced.

(To be continued.)

The Zeppelin Airship LZ 127.

The German airship LZ 127, or "Graf Zeppelin," as she is now called, after a long period of construction in the Friedrichshafen sheds of the Zeppelin Airship Company, was successfully launched on September 18th, and on that date and subsequently performed satisfactorily on her preliminary trial flights. Very considerable interest attaches to this vessel, not only because, in a sense, she may be regarded as a rival to the two large airships now nearing completion in this country, but because she is, or may be, the herald of a new method of operating airships. While we in this country—in the case, at any rate, of the Government airship R 101—are seeking to reduce the risk of disaster and to secure other incidental advantages by using heavy oil engines, the Zeppelin Company aims at the elimination of petrol by employing as fuel a combustible gas, the outstanding characteristic of which is that its density is approximately the same as that of air.

Little official information concerning the nature of the fuel gas to be employed has so far been published. According to one report it is known as "blaugas." That name suggests some form of water gas or oil gas. In reality, however, blaugas is the invention of Herr Blau and consists of a mixture of volatile hydrocarbons and illuminating gas held in solution under pressure and supplied in steel cylinders for lighting purposes. It is possible, of course, that it is the company's intention to charge the fuel gas bags of its airship with "blaugas" manufactured on the spot or obtained from cylinders. It cannot be its intention to take the gas on board in solution under pressure in cylinders, for to do so would be to defeat one of the principal incidental advantages claimed for the use of the new airship fuel, namely, compensating the weight of gas consumed as fuel by the admission of air to the fuel gas bags as they become empty.

In its recently published British patent specification the Zeppelin Company refers to ethylene as the fuel gas to be used. Ethylene, as we showed in a leading article published in our issue of July 30th, 1926, possesses a calorific value and a density which agree very closely with those which, on Dr. Eckener's authority, characterise the proposed fuel gas. On the other hand, it must be admitted that the existing methods for the production of ethylene on a commercial scale are expensive to operate. Unless some new method of manufacture has been discovered the task of providing the 1,000,000 cubic feet of fuel gas said to be required to take the vessel across the Atlantic will be a formidable one.

So far, it appears, the vessel has not made use of gas as fuel for her engines. Her five twelve-cylinder, 570 horse-power Maybach motors are designed to run either on gaseous or liquid fuel, and on her trial flights, in deference apparently to the wishes of the Ministry of Communications, she was driven by means of petrol.

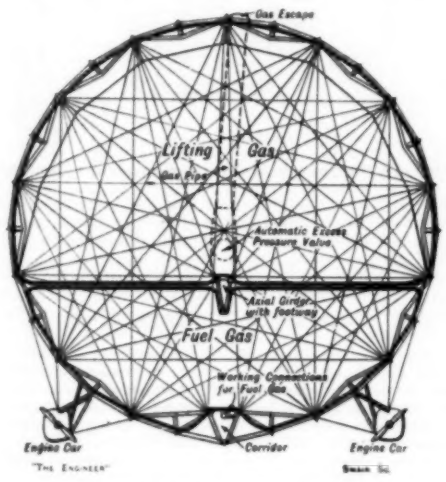
The elimination of petrol is by no means the sole or even the principal object of employing the new gaseous fuel. As an ordinary airship proceeds on its voyage and consumes its fuel and stores it has to blow off its hydrogen in order to reduce the lift in keeping with its reduction of weight. On the voyage from here to India the new British airships will, we believe, be called upon for this reason to discharge about a million of the five million cubic feet of hydrogen with which they will start the voyage. In other words, something of the order of 20 per cent. of the initial gas content is required to lift the initial load of fuel and becomes superfluous during the voyage. This enforced loss of hydrogen is an expensive item in the operation of airships. In order that it may not represent a total loss efforts have been made to devise a system whereby the discharged hydrogen may be used in replacement of a portion of the liquid fuel supplied to the engines. The experimental work in this

direction has now been taken over in this country by the Government, but what progress has been made with it is not known. In neither the R 100 or R 101, the one with petrol, the other with heavy oil engines, will the surplus hydrogen be used as fuel according to present arrangements.

The Zeppelin Company's plan goes beyond this compromise. The use of a gaseous fuel of the same density as air and the filling up of the gaseous fuel bags with air as they become empty of the fuel gas preserves the weight of the vessel at the initial value throughout the voyage and therefore renders it unnecessary to discharge any hydrogen. The practicability of the scheme clearly hinges upon the nature and properties of the fuel gas. In the case of ethylene the calorific value and density are such that the volume required to accommodate the gaseous fuel for a voyage of given length is not greater than the volume of hydrogen which in a petrol driven vessel would have to be provided to lift the weight of liquid fuel at the outset of a voyage of equal duration.

According to recent information, the LZ 127 has a length of about 780ft., a maximum diameter of about 100ft., and a gas capacity of about 3·7 million cubic feet. These dimensions may be compared with those of the R 101, which has a length of 724ft. 3in., a maximum diameter of 131ft. 8in., and a capacity of 5,000,000 cubic feet. It will be seen that the German vessel is actually some 56ft. longer than the British and that the R 101 maintains its claim to being the biggest airship in the world on the strength of her diameter and the extra capacity which increase of that dimension entails. A little calculation indicates that the 3·7 million cubic foot capacity of the LZ 127 must include both the hydrogen and the fuel gas capacity.

In the accompanying engraving we reproduce from the *V.D.I. Nachrichten* a cross section of the new German airship. A comparison of this cross section



CROSS SECTION OF AIRSHIP LZ 127

with that of the airship LZ 126—now the United States airship "Los Angeles"—published in our issue of December 7th, 1923, shows that the design of the transverse frames is of the standard Zeppelin type and that no attempt has been made to introduce any new principle. This fact is in marked contrast with the fact that in the British airship R 101, as we showed in our issue of August 31st, 1928, an entirely new design for these important details of the airship's structure has been evolved by the staff at Cardington. There is, however, one important addition in the design of the "Graf Zeppelin." It will be seen that somewhat below the level of the longitudinal axis an axial girder is placed between the upper hydrogen bag and the lower power gas bag. This girder, it would appear, runs continuously throughout the whole or the major portion of the ship's length and contains a cat walk for the crew. The main longitudinal passage way is, as in the earlier vessel, the LZ 126, contained in a corridor in the "keel" of the framework.

It is not easy to reconcile the existence of this longitudinal axial girder with the intention of the Zeppelin Company revealed in a recent patent specification—see page 159 of our issue of August 10th, 1928—to vary the relative proportions of the cross section assigned to the hydrogen and the fuel gas in such a way that the lifting force at any one section shall be approximately in keeping with the bending moment at that section. The specification referred to shows the gas contained in thirteen sections. In some of the sections the power gas bag extends up to a considerable height above the centre line, while in others the hydrogen bag occupies nearly the whole of the available space. We take it that this patent is not made use of in the LZ 127 and that in all sections the hydrogen and power gas bags have the same relative proportions as shown in our engraving.

The automatic excess pressure valve in the hydrogen bag discharges the gas through an ascending trunk which ends in a cap outside the skin of the vessel. There is no automatic valve attached to the power gas bags. Any excess pressure in these bags is relieved by their upward expansion against the hydrogen bags and the release of hydrogen therefrom.

The passenger and engine car arrangement follows closely that adopted in the LZ 126. The passenger quarters and control room are arranged in an external structure lying against the underside of the hull near the nose. The engine cars are slung outboard in two pairs and a fifth on the centre line aft. The engines drive without transmission gearing and run at 1600 revolutions per minute. Their cylinders are arranged in two banks of six each arranged in a V and have a diameter of 140 mm. and a stroke of 180 mm. They are water cooled and are fitted with a sliding cam shaft for reversing the direction of rotation. A two-stage air compressor can be coupled up to each engine to supply air for starting or manœuvring purposes.

Fuel Research.*

Coal Sampling.

Through the courtesy of the South Metropolitan Gas Company, it has been possible to carry out an extensive programme of work on the sampling of ships' cargoes. Seven cargoes shipped from Newcastle to the gas company's wharf at East Greenwich were sampled, both at the point of export and during discharge. The coal chosen for these tests was in each case a Durham gas coal of a hard type, in order that the percentage of large coal might be as high as possible. At Newcastle, the sampling was carried out under the direction of Major Bywater, the gas company's representative, and Dr. Dunn, a member of the Sampling and Analysis of Coal Committee, acting independently. The former sampled from a flowing stream of coal, and the latter from the surface of trucks. On arrival at East Greenwich, the cargo was sampled by members of the staff of the Fuel Research Station. In the first cargo two samples were taken by the surface method after the coal had been transferred to small trucks, one being approximately 0·1 per cent. of the cargo and the other 0·01 per cent. In the remaining six cargoes an additional sample, representing about 0·2 per cent. of the cargo, was taken from the flowing stream of coal. Major Bywater and Dr. Dunn, after analysing their own samples, forwarded them to the Research Station for analysis, and the samples collected at East Greenwich were analysed both at the Research Station and by Dr. Dunn. In so far as conclusions can safely be drawn from the small number of cargoes already dealt with, it may be stated that sampling from the flowing stream appears to give not only satisfactory, but repeatable results for the ash content, while the removal of a sample by digging into the surface of the stationary coal gives results varying considerably on either side of the values obtained by the flowing stream method. The variations are greater in the case of the smaller surface samples and showed wide disagreement between samplers. It is to be expected that the larger the sample taken the more accurate will be the result, and the higher the cost of obtaining it. The method to be adopted in any given case should be the cheapest method that will give the accuracy necessary. It is a waste of money to use a method giving an unnecessarily accurate result when a cheaper method is good enough, but it is even more wasteful to use a method, however cheap, if the results are not sufficiently accurate for the purpose in hand. Further information is still required before the accuracy to be expected from the different methods can be stated.

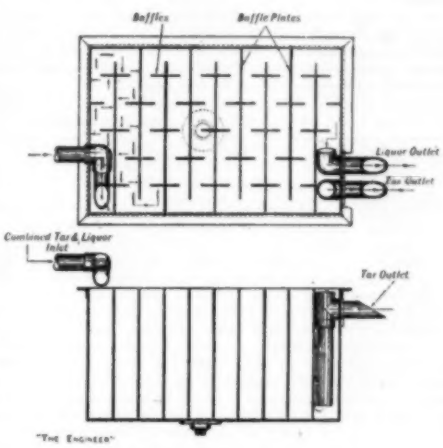
Purification of Water Gas.

The removal of sulphur from water gas is of special importance where the gas is to be used for synthetic processes, or for the manufacture of hydrogen, and a general investigation into the methods of its removal has been in progress. As a first step the sulphur compounds were isolated by passing the gas through a tube immersed in liquid air. It was found that the sulphur content of 100 cubic feet of scrubbed water gas was 25 to 30 gr., of which 85 to 90 per cent. was present as hydrogen sulphide. Sulphur dioxide is present, if at all, only in traces. Carbon disulphide is occasionally present. Carbon oxysulphide is present to the extent of one or two grains per 100 cubic feet. The composition of the remainder is not definitely known. Indications of the presence of mercaptans have been obtained, but thiophen appears to be absent.

Scrubbing the gas with a stream of a 33 per cent. solution of caustic potash reduced the sulphur to 2 to 3 gr. per 100 cubic feet. Activated charcoal is found to remove 95 per cent. of the sulphur, and if the gas is so treated, and then scrubbed with caustic potash, the residual sulphur is too small in amount to be detected by the usual methods.

Separation of Tar and Liquor.

A separator, for separating the tar and liquor as they leave the condensers, has been in use in connection with the various retorts at the Fuel Research Station. This separator has been very successful, and has aroused considerable interest among such gas engineers as have seen it. It is thought that the following particulars may be of interest:—The principle is that of a labyrinth. The path of the mixed tar and liquor from one end of the separator to the other is obstructed by vertical baffles, which cause it to change direction at right angles very many times. It would appear that on each occasion when the particles impinge upon an obstructing surface there is a tendency to assist the separation. The accompanying engraving shows a diagram of the separator. The separator actually in use at the Station is dealing satisfactorily with the tar and liquor from the vertical retorts in which 10 or 15 tons a day are being carbonised. Information with regard to the separators, including blue prints, has been given to a variety of inquirers. As a result of one of the inquiries, a separator was erected by a gas company for dealing with some 8000 gallons of tar and liquor per day from a setting of vertical retorts. A continuous separation was maintained in which the liquor content in the tar was reduced to 4 or 5 per cent.



TAR AND LIQUOR SEPARATOR

Low-temperature Carbonisation.

Slow, but steady, progress has been made during the year 1927 towards the accumulation of the data necessary for determining to what extent, and under what conditions, low-temperature carbonisation of coal will be a commercial success.

As mentioned in the report of the Fuel Research Board for 1926, and announced in the House of Commons on May 11th, 1927, the Gas Light and Coke Company was asked by the Government to examine all existing low-temperature carbonisation plants, and consider whether it was prepared to try out that process which appeared to it the most promising for working in conjunction with a London gasworks. It is gratifying, but in some ways embarrassing, that the company selected for the purpose the process developed at the Fuel Research Station.

The conditions under which this bank of retorts, of a size calculated to produce 100 tons of coke per day, is being erected, ensure a thorough trial for two or three years, and the knowledge and experience gained will be placed freely at the disposal of all interested.

Certain modifications in the design of the retorts and in the method of heating adopted have been made as the result of experience gained at the Fuel Research Station with the original retorts, and special metal is being used which it is hoped will better withstand the working conditions without distortion. Work is in hand at the Richmond Gasworks, where it is expected that the retorts will start work before the end of 1928.

Progress has also been made by private firms and individuals. The new plant of Low-Temperature Carbonisation, Ltd., at Barnsley, started work in July, 1927, and has a capacity of about 1000 tons of coke a week. The Director has visited the plant, which is generally similar to that tested by his staff in 1924. The report of the test indicated points where modification in design was desirable and these suggestions have been acted on in erecting the new plant. The advice of the British Cast Iron Research Association was sought by the makers of these retorts as to the metal mixture and analysis to be used. A metal of similar analysis to that recommended is being adopted at the Richmond Gasworks and at the Fuel Research Station for the new retorts.

The Maclaurin plant, installed at the Dalmarnock Gasworks of the Glasgow Corporation, has a capacity of about 100 tons of coal a day, and has now been running for over two years. The plant has been visited by the Director of Fuel Research, and an official test was carried out in May, 1928. It is understood that the plant has given but little trouble on the technical side, but that it suffers from not having, in the particular local conditions, a profitable market for the gas produced. This gas is of too low a calorific value for use in the local gas supply to the town. The plant is of the internally heated type, and is suitable for certain types of coal only. The local conditions necessary for its successful commercial working are quite different from those required by externally heated retorts of the type being erected at Richmond or that in use by Low-Temperature Carbonisation, Ltd.

There are at least four plants of other types in existence, with a designed capacity of about 100 tons of coal a day, and several more are stated to be under erection, while there are yet others working on a scale of about 10 tons a day.

As has been stated before, progress in development is necessarily slow, but the number of large-scale plants is steadily increasing.

Hydrogenation of Coal.

The intermediate scale Bergius plant at the Fuel Research Station, mentioned in the last report, has been working since February, 1927, and much experience has been gained. This plant is of the continuously working type, and has a capacity of about 1 ton of coal a day. The difficulties which are inevitable in starting an experimental plant of this nature have been overcome, and the staff now has the knowledge and experience necessary to work the plant. The amount of oil obtainable from a ton of coal by this method is some six or more times that obtainable by carbonisation methods. The cost of the process cannot be known until it has been tried out on a far larger scale than is the case at present, but with our present knowledge it is safe to assume that the cost would be considerably greater than the price at present ruling for imported oils, although it should be less than the prices of imported oils which ruled in 1917–18.

There are several directions in which improvements, to reduce the cost of working, may be expected, notably in the cost of hydrogen production, or in the recovery and

* Excerpts from the Report of the Fuel Research Board for the period ended March 31st, 1928, published by H.M. Stationery Office, price 1s. 3d. net.

re-use of the hydrogen in the gaseous products of the process.

The option on the rights in the process for the British Empire, given by the various agreements between the Department, the British Bergius Syndicate, and the International Bergin Company, continues until a full size plant has been erected and worked for six months under conditions giving the Syndicate and the Government full information as to the working and facilities for inspection. In the meantime, Imperial Chemical Industries, Ltd., has obtained a controlling interest in the Syndicate, and is experimenting at its own works. There is no doubt that this firm is in an exceptionally favourable position for developing the process. It is essential from a commercial point of view that all the products of the process should be utilised to the best advantage, and it seems quite possible that the most economical way of getting the necessary hydrogen and utilising the gas produced by the process, is to combine the plant with coke oven plant, and with the manufacture of synthetic ammonia, and possibly with low-temperature carbonisation plant.

In view of the action of Imperial Chemical Industries, Ltd., the work at the Fuel Research Station is not directed towards examining the immediate commercial possibilities of the hydrogenation of coal, but rather consists of a close study of the chemical reactions involved in the process, in view of their fundamental importance. The investigations are being carried out partly with the above-mentioned plant, and partly in the small-scale intermittently working bombs, and may prove of importance in other directions, as the results obtained throw some light on the constitution of coal and on the factors which determine its caking properties. It has been found that with every coal tested, even anthracite, hydrogen is absorbed under suitable conditions of temperature and pressure, and that this results in a definite increase in its caking power. For example, a particular coal which, if carbonised in its natural conditions, produces a solid residue with no adhesion between its original particles, was treated in the Bergius apparatus in a less extreme way than is necessary for liquefaction, and yielded a product which proved to be more strongly caking than any known coal. On carbonisation it yielded an excellent coke even when mixed with two or three times its weight of raw non-caking coal. The tar yields were also increased.

It has long been known that the caking properties of a coal could be reduced or destroyed by slight oxidation, but it has not previously been possible to increase them, or replace them when once destroyed. Detailed results of this work will be published in due course.

The work in Dr. Bergius' works at Mannheim–Rheinau, which was being carried out by a joint committee of the parties to the agreement referred to above, was discontinued at the end of May, 1927, by mutual agreement.

Internal Combustion Engines.

Diesel Engine.—A quantity of fuel oil suitable for Diesel engines has been prepared from low-temperature tar, by rejecting the lighter fractions and the pitch and retaining the portion distilling between 200 deg. and 350 deg. Cent. The preliminary trials with this fuel on the Station Diesel engine with normal spray valves showed that the fuel had a tendency to give a delayed ignition followed by heavy detonation. A modified form of spray valve has been designed to give better pulverisation and mixing with the air blast, and it is believed that this type of valve overcomes the difficulties attending the use of this fuel. The most satisfactory method of using this fuel has, however, been as a blend with shale oil when using the normal spray valves. A blend of one part of tar oil with about four parts of shale oil has been the standard fuel for the Station Diesel engine for a period extending over several months. Similar work to the above has been carried out at the Admiralty engineering laboratories at West Drayton on an experimental Diesel engine. Blends of the tar oil with ordinary fuel oil were made up, and suitable modifications to the fuel valves made to enable blends containing increasing quantities of tar oil to be used. Ultimately, a suitable form of valve for running on pure tar oil was evolved, and a series of tests was conducted, including an endurance test of 100 hours. These tests indicated that when allowances are made for differences of calorific value the consumpton of tar oil is practically the same as that of an ordinary fuel oil. No difficulty was experienced with choked fuel valves or carbon deposit, and the condition of the engine when opened up after the tests was in every way normal.

Dorman Engine.—Tests have been carried out when using two different types of low-temperature spirit. The first, referred to as gas spirit, is prepared by scrubbing from the gas made during low-temperature carbonisation of coal, and the second, referred to as tar spirit, is distilled from the tar obtained by low-temperature carbonisation. Gas spirit, as is to be expected, contains a larger proportion of light fractions than the tar spirit. This is probably the explanation of the excellent starting properties of gas spirit when used in an engine. Starting is, if anything, easier than on petrol, but, on the other hand, with tar spirit starting is extremely difficult, and a start on petrol with subsequent change-over to tar spirit is usually resorted to. Both spirits have high anti-knock values, and no difficulty is experienced with "pinking." The consumptions obtained compare favourably with those obtained with petrol as fuel. Apart from the possible use of these fuels for blending with petrol to increase its anti-knock value, a blend of gas spirit with tar spirit in equal quantities would produce an excellent straight fuel with good starting and flexibility properties, freedom from pinking and consumption comparable with the best obtained from normal petrol fuel.

Ricardo Research Set.

A series of tests has been carried out to illustrate the influence of compression ratio, mixture strength, and other variables on engine efficiency and economy. These tests were carried out with benzole as fuel, and constitute the second part of the detailed standardisation of the set.

Some determinations of the highest useful compression ratio have been made, including a series of blends of low-temperature tar spirit with petrol. These indicate that in this connection, and particularly for quantities up to 20 per cent. by volume, the tar spirit is of practically the same value as benzole for anti-knock properties.

Power Alcohol.

Research work on the chemical side of power alcohol production in the Empire overseas was undertaken at the University of St. Andrews, but it soon became apparent that there was little hope of devising a feasible chemical process, and work in this direction was consequently discontinued. As the Royal Naval Cordite Factory in Dorset was well staffed and equipped for research on the bacteriological side, work was started there in the early part of 1920, under Dr. A. C. Thaysen, and proceeded until the end of March, 1927.

The investigation had for its object the discovery of a method of converting cellulosic materials, such as grasses, straws, and waste vegetable materials, mainly of tropical or semi-tropical origin, into alcohol by either direct bacterial attack of the material, or by a combined chemical and bacteriological treatment. Very little progress was made with the difficult matter of direct conversion, but the work on the combined process was carried to the small, semi-technical scale unit. The process consists in conversion of the pentosans of the cellulosic materials into pentoses by a simple acid hydrolysis process, not necessitating the use of autoclaves, and the subsequent fermentation of the pentoses to a combustible liquid consisting of a mixture of approximately 90 per cent. alcohol and 10 per cent. acetone, quite suitable as a fuel for internal combustion engines. The result of the work has established the details of a process which should present no real technical difficulties once the raw materials are available in sufficient quantity and at a sufficiently low cost. Where waste vegetable materials can be treated where they are available without further expense of collection it would appear that their conversion into alcohol for use in internal combustion engines as an alternative to petrol should be investigated from the point of view of the suitability of the process to local conditions and of that of costs. The question of grasses, however, would be a somewhat different one, owing to the fact that the cost of harvesting and transporting them might make their use economically impossible. This again is a matter depending on local conditions once their technical suitability for the purpose has been established.

The matter of the home production of power alcohol was also studied at the Royal Naval Cordite Factory, and grain being out of the question for the purpose, the possibilities of potatoes, mangolds and Jerusalem artichokes were investigated. Mangolds and artichokes were specially cultivated at various places in order to study the average yield, the nature and content of fermentable matter and the alcohol yields. The conclusion arrived at was that the Jerusalem artichoke was the most promising of the three vegetables, but that, even in times of emergency, shortage of ground would prevent its being grown in sufficient quantities to supply any appreciable proportion of the home requirements of fuels for internal combustion engines.

These investigations have extended over six years, mainly in connection with the production of alcohol by fermentation processes, and have proved that such alcohol cannot, in this country, become a commercial alternative to petrol at anything approaching its present low price, as a fuel for internal combustion engines, because it is impossible to produce the necessary raw materials in sufficient quantities and at sufficiently low prices. A simple process has resulted, however, from the work at the Royal Naval Cordite Factory which would be well worth further investigation in the Empire overseas.

Whilst the investigations on the production of what may be termed fermentation alcohol for power purposes have ceased, machinery still exists for watching processes and developments, so that the Department could take further active measures should it at any time become desirable.

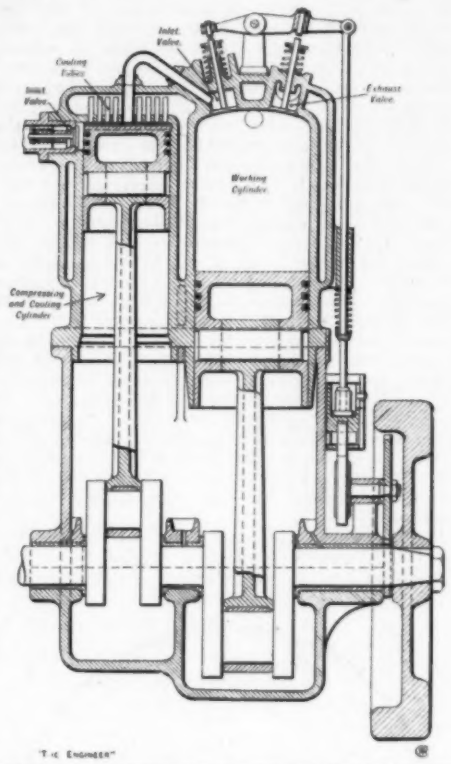
Since the research which has been outlined above was started, new processes for producing liquid fuels synthetically from coal have been introduced, and it may well be that the solution of the problem of home-produced fuels for internal combustion engines may be solved on this basis.

The "Hult" High Compression Internal Combustion Motor.

Some weeks ago we made a short reference in a note to a new engine invented by Mr. O. W. Hult, the chief engineer of the Aktiebolaget Archimedes, of Stockholm, which constructs the "Archimedes" outboard motors. The chief feature of the new engine is the subjecting of the charging air to considerable cooling before it enters the main cylinder, so that a higher cylinder compression with a consequent increase in efficiency can be obtained. Tests have been carried out on a twin-cylinder experimental unit. The diagram shows a section through one of the main cylinders and the compressing and cooling cylinder for the air charge. In the crown of the compressor cylinder there is arranged a nest of small copper tubes with sealed ends which are surrounded by the jacket cooling water.

When the main piston is moving upwards on its first stroke the compressor piston is moving downwards and air is drawn into the cylinder through the inlet valve and is compressed into the nest of cooling tubes on the second upward return stroke. On the third stroke of the compressor the already cooled air is allowed to expand and do work on the piston, so that it is still further cooled, and temperatures lower than atmospheric are easily attained. On the fourth or return stroke the cold air is charged into the working cylinder. The air inlet and exhaust valves of the main cylinder are mechanically operated and are timed to work in conjunction with the air inlet valve on the compressing and cooling cylinder. For ordinary petrol engine running, with a good grade of commercial petrol, the highest useful compression ratio may be about 5 : 1. In the experimental engine we illustrate, compression ratios up to 8 : 1 were successfully employed, and the inventor is, we learn, now making further experiments with still higher compression ratios.

The following are some results which have been obtained from the experimental engine referred to :—When working with a brake mean effective pressure of 135 lb. per square inch or 9·5 kilos. per square centimetre, the fuel consumption was 0·500 pint, or 203 grammes per brake horse-power hour. At 115 lb. pressure, or 8·1 kilos. per square centimetre, the consumption was 0·474 pint, or 192 grammes per brake horse-power hour. It is expected that, adapting a petrol engine of good design to this principle of working, an average consumption of 0·590 pint per brake horse-power hour will be obtained at a brake mean effective pressure of about 90 lb. Mr. Hult has, we are informed, investigated many other means of cooling the air charge, but he finds that the one we have illustrated is the most practicable.



Section Through Cylinders of Hult Engine

Books of Reference

"Kelly's Directory of the Engineering, Hardware, Metal and Motor Trades, 1928." Published by Kelly's Directories, Ltd., 186, Strand, London, W.C. 2. Price 45s. net, post free—This year's issue forms the eighteenth edition of this useful book of reference. It is now too well known to require any detailed introduction, but we may say that it comprises, first of all, a section containing the names for each county arranged alphabetically under towns and villages. Then there is a section devoted to an alphabetical classification of trades for the London postal district with the names arranged under each trade heading in alphabetical order. It is followed by a similar classification of trades for the rest of England, for Scotland and for Wales. There are also sections giving :—(*a*) An alphabetical list of the names of some ten thousand branded articles and specialities used in the engineering and allied trades, together with the names and addresses of the manufacturers ; (*b*) an alphabetical list of the names—with addresses—of the manufacturers of iron and steel sections, together with information regarding the sizes, &c., made by each ; and (*c*) a list of various brand signs which appear on iron and steel work, together with the makers' names and addresses.

The report of Lieut.-Colonel Mount on the collision of July 9th at London Bridge, was issued on Monday, October 1st. It will be remembered that as an electrically-operated passenger train was leaving the central, or Brighton Station and passing on to the down local line, it was run into broadside by a light engine that had come out of No. 1 engine siding with a "clear" signal. The driver of the latter had been told that he had, "when it is convenient," to go to New Cross Gate and seeing another signal ahead of him at "clear," he proceeded on his way and overlooked an intermediate signal which was at danger. One passenger was killed and another died two days later from his injuries. The whole of the signalling at London Bridge was re-arranged on June 17th, and light signals substituted for semaphores. It is therefore satisfactory to find from Colonel Mount's report that from the end of April onwards drivers, guards, signalmen, and others concerned were being educated in the new arrangements. No. 1 engine siding is in the low-level station of the eastern, or South-Eastern Station, and that was the first occasion on which the driver of the light engine had been there since the new signalling had been introduced. Colonel Mount remarks thereon that "The only excuse which I can find for his regrettable mistake, for which he is solely responsible, is that he was really over-confident of his own ability to grasp the fundamental principles of the system of signalling, to which he was working." The report suggests three safeguards against similar mistakes, but the inspecting officer observes :—"I am not satisfied that it would be entirely reasonable to suggest the introduction of such safeguards which amount, in effect, to the provision of protection against mistakes which it is the primary duty of drivers to avoid."

Railway Matters.

THE recent completion of the last important bridge in the bridge renewal programme of the East Indian Railway has enabled the major proportion of the wagons on that system to have their carrying capacity marked up from 19 tons to 22 tons, giving an equivalent in total extra carrying capacity of an additional 3500 wagons.

IN the early hours of Thursday, September 27th, the express for Edinburgh, which had left St. Pancras at 9.15 p.m., ran into a goods train just north of Chesterfield Station. A dense fog prevailed at the time. Fortunately the express had to travel by the old route through Staveley, and there is a speed restriction of 10 m.p.h. for passing through the crossover junction at Tapton Junction, so its speed was low. The damage done was, therefore, material and not personal.

A REPORT from Moscow states that the expert commission appointed by the Commissariat of Ways and Communications to compare the respective qualities of foreign automatic brakes and those invented by Soviet engineers has concluded its work. The examination of the various systems has led the commission to recommend the Kazantsev brake, series K, and this brake is to be fitted to goods wagons on the Soviet railways. The study of new brakes of Soviet invention is being continued.

IN view of the frequent suggestion in the Press that first-class fares should be abolished, it is instructive to note that according to the Railway Returns for 1927 the average first-class fare received is 5s. 5·56d., as compared with 1s. 2·42d. for a third-class, and that the first-class season ticket holder pays on an average £28 7s. 7d a year, as against £11 5s. 4d. from the third-class. Further calculations of our own, based on figures in the Returns, show on the other hand, that each third-class seat earns £32·18 a year, whilst each first-class brings in £24·58.

IN the first paragraph in this column of our issue of August 24th we expressed the anticipation that the next and final stage of the electrification on the Southern Railway would be completed earlier than the date, March 3rd, provisionally fixed. In that connection it may be noted that the conductor rails are already in position between Victoria and Epsom—where they join the existing electrification from Waterloo to Dorking—and, for the London Bridge trains, between Peckham Rye Junction and Streatham Junction. Between Sutton and Cheam there are four lines of way, but only the local, or outer, lines have the third rail.

IT is officially announced that the directors of the London and North-Eastern Railway have appointed Mr. Thomas Hornsby to be the divisional general manager of the North-Eastern area, in place of the late Mr. George Davidson. Like his predecessor, Mr. Hornsby has had a legal training, having served his articles with the then town clerk of Darlington, when, in 1895, he joined the North-Eastern Railway and eventually became the rating assistant to the secretary and solicitor, under Mr.—now Sir Francis—Dunnell. On the formation of the London and North-Eastern Railway in 1923 Mr. Hornsby was made goods manager for the North-Eastern area, which position, on his promotion, he now vacates.

THE completion of the negotiations for the sale of the Provincial railways to the Canadian Pacific Railway with power to the Canadian National Railway to participate in the obligations and benefits is announced by the Provincial Government of Alberta. The price is reported to be 25,000,000 dollars, which includes the payment of the first mortgage bonds of Edmonton, Dunvegan, and British Columbia Railways to the extent of 9,420,000 dollars, and the payment of 15,580,000 dollars spread over a period of ten years. The purchasers also assume the cost of extensions now in progress which will probably amount to another million dollars. The agreement is subject to ratification by the Dominion Parliament, the Provincial Legislature, and the shareholders of the railways concerned.

SOME thirty or so years ago, after a serious collision in Park-avenue Tunnel, the State of New York passed an ordinance ordering the New York Central to work all its trains into and out of the Grand Central Station electrically. The large open spaces that then existed in order to allow the smoke and steam from locomotives to escape were afterwards no longer required, and they were built over by hotels, apartment houses, business premises, &c., and large sums thereby come to the railway company for rentals. Something similar, but on a much smaller scale, has been done in this country by the Metropolitan Railway. We are reminded of this source of wealth for railway companies by a letter in *The Times* on September 21st from a firm of house agents who say that they urged the Southern Railway to build shops across the railway at Putney. The idea was not accepted, nor was a later proposal that the company should let the site on a building lease. The firm writes that the latter is now being done, and that the shops are let in advance. It claims that similar action elsewhere would bring in a large annual income without any effort on the part of the railways.

THE Board of Trade returns for July show that the value of the railway material exported during the first seven months of the present year was as follows, the corresponding figures for 1926 and 1927 being added in brackets :—Locomotives, £2,219,866 (£1,114,147, £2,284,946) ; rails. £2,159,035 (£1,545,452, £1,208,619) ; carriages, £1,718,156 (£1,932,725, £1,495,181) ; wagons, £2,051,622 (£1,410,844, £1,988,851) ; wheels and axles, £523,927 (£369,714, £330,642) ; tires and axles, £346,406 (£332,430, £184,685) ; chairs and metal sleepers, £614,417 (£742,032, £593,376) ; miscellaneous permanent way, £857,795 (£913,216, £712,244) ; total permanent way, £4,756,256 (£4,071,432, £3,158,887). The weight of the rails exported was 249,728 tons (188,371 tons, 153,124 tons) ; and of the chairs and metal sleepers, 61,897 tons (74,753 tons, 61,484 tons). During the month of July last the value of the locomotives sent overseas was £168,622, and included :—India, £124,810 ; Ceylon, £11,510. The rails shipped during the same month were of the value of £291,533, and included :—The Argentine, £52,957 ; India, £46,485 ; New Zealand, £20,637 ; Portuguese East Africa, £19,181 ; British South Africa, £5935.

Notes and Memoranda.

CAPE BRETON coals, characterised by high-volatile content and long-flame burning, are, it is said, especially suitable for dust-fired use, and since the ash content is moderate, there is actually no ash-disposal problem, as the incombustible residue is carried off by the funnel draught.

ACCORDING to the *Iron and Coal Trades Review*, Krupp's, of Essen, now produce cutting tools of tungsten carbide by compressing tungsten carbide powder mixed with a little cobalt, nickel, or iron powder as a binder, sintering at 1000 deg. Cent., shaping, and then finally sintering at about 1500 deg. Cent.

A CERTAIN manufacturer had to set a large number of light machines on a rented concrete floor. His landlord did not permit the cutting of the floor to anchor the machines. The problem was solved by making a mass of silicate of soda and sawdust, which formed a mound around each foot of the machines, and so bound them adhesively to the cement floor.

AN article in the *South African Mining and Engineering Journal* describes at some length a process which has been evolved at the Corner House, Metallurgical Department, by Mr. K. Graham, for the extraction of platinum from sulphide norite ores. It is said that with platinum at 16s. per dwt., 2½ dwt. recovery will cover the whole cost from the ore bin to the finished product.

FOR refractory cements mixed with silicate solutions, calcined clays, bauxite, chromite, silica and asbestos have their place. Where the temperature is not such as to test the resistance of the silicate, a large variety of other earthy materials can be used with economy. Almost any local earth can be mixed with silicate solution and be used to make a gas-tight closure for coke oven doors. Powdered coal ash yields cement suitable for stopping air leaks in domestic heating apparatus.

IT is claimed by an American firm that by treatment with zirconium inclusions that would cause shock and fatigue failures can be eliminated from carbon and alloy steels. Zirconium is added to the steel in the form of silicon-zirconium for the manufacture of high-pressure castings and spring steel where extreme purity is required as a guarantee against failures due to shock and fatigue. Silicon-zirconium is an electric furnace product low in impurities. A typical analysis is :—Zirconium, 35 to 40 per cent.; silicon, 47 to 52 per cent.; iron, 6 to 10 per cent.; and carbon, 0·50 per cent. max.

PURE beryllium is an extremely hard and brittle metal which scratches glass and can neither be rolled nor drawn because of its coarse crystal structure. Since beryllium has a specific gravity of 1·8 it has been considered advisable to try to alloy it with sufficient aluminium to make it workable. In this respect many interesting results may certainly be expected. Americans have made valuable contributions to the study of beryllium-aluminium-lithium alloys, indicating that beryllium must not cost more than 20 dollars per kilogramme to make alloys of economic value. But this low figure is still in the distant future.

A SYSTEM of utilising waste vegetable material for the production of power alcohol has been evolved by Messrs. A. C. Thaysen and L. D. Galloway. With it such materials as maize cobs, &c., are hydrolysed by dilute acids and the resulting liquor fermented to give a mixture of ethyl alcohol and acetone, eminently suitable as a motor fuel. No pressure vessels are required, and yields averaging 20 gallons per ton of dried material are reported. The organism employed is the pentose-fermenting *Bacillus acetoethylicus* (Northrop), and the conditions required for a successful large-scale fermentation by this organism are fully described in the August issue of *Annals of Applied Biology*.

A SMALL plant utilising the small temperature difference of water, which may, for instance, be experienced at different depths in the ocean—a principle to which we have already referred—has recently been laid down at Ougrée-Marihaye, in Belgium, lately, which works with the difference between the temperatures of the waste hot water from the steel works and the cold water from the bottom of the river Meuse. The plant uses hourly 750 cubic metres of cold water and a similar quantity of tepid water, the difference of temperature being from 15 deg. to 20 deg. Cent. The water is pumped into condensers, and the warm water is partially vaporised by the vacuum and loses 3 deg. by cooling during its passage through the turbine, and is immediately exhausted. The cold water condenses the steam and rises in temperature 3 deg., when it is also exhausted. The turbine rotor has a diameter of 1 m. Running with a difference of pressure of 15 cm. to 20 cm. of water at 5700 revolutions per minute, it drives a dynamo which delivers from 55 to 60 kW. The energy required for the pump and for extracting the dissolved gases mixed with the steam is 18 to 20 kW., so that two-thirds of the energy is available for use.

IN a paper concerning the procedure adopted at the Pretoria Mint, contributed to the South African Institution of Engineers, Mr. J. T. Becklake said that the moulds used for casting gold bars are of grey cast iron and that if the stream of metal in pouring touches the sides of the moulds local heating and splashing takes place, and, in consequence, local "blowing" occurs in greater or lesser degree, depending on circumstances. Experiments have been made with tilted moulds to reduce the tendency for the stream of metal to strike the sides and to facilitate the escape of gases, but it is difficult to lay down any definite rule for producing the best results. Much depends on the apparatus used in pouring and on those carrying out this operation. In the Pretoria Mint present practice is to give the moulds a slight tilt—approximately 5 deg. from the vertical. Some mints, he said, definitely prefer a vertical mould, whilst others use moulds with considerably more tilt than 5 deg. In the case of coinage bar moulds with a length of 2ft., the pouring process requires considerable skill and constant care if sound bars are to be produced, especially when hand pouring is practised. In fact it might be claimed that casting of strip ingots is not so much an exactly defined engineering process, but rather an art needing a special temperament and facility of operation for its success.

Miscellanea.

THE Safety in Mines Research Laboratories at Sheffield are to be opened by the Prime Minister on October 11th.

THE Cowgarth iron ore mine of Lord Leconfield, at Cleator Moor, has been reopened after eight months' idleness.

THE work of replacing the old L.N.E.R. bridge at Gateshead, which was completed on October 1st, occupied 26½ hours.

ARRANGEMENTS are being made for the development of 120,000 horse-power at the Nigger Rapids on the Gatineau River, Ontario.

A PULVERISED-FUEL installation, on the Duffield gyro system, is in course of erection at the Glasgow works of Stewarts and Lloys, Ltd.

THE last of four paper-making machines, each 234in. wide, has been put into operation at Spruce Falls, Kapuskasing, Ontario. The mill has a capacity of 500 tons of newsprint a day.

THE McLeod No. 4 well, which has recently been completed in the Turner Valley, Canada, is producing natural gas at the rate of 20½ million cubic feet a day. The gas carries a considerable proportion of spirit.

A EUROPEAN expert, who was instructed by the Persian Ministry for Public Works to investigate the coalfield at Shamshek, reports that the deposit in question is one of the richest in the world. A new road, and eventually a railway, is to be built from the coalfield to Teheran.

THE production of marketable quantities of material has been started by Diatour Products, Ltd., at Little River, Nova Scotia. The company possess a large deposit of diatomaceous earth which is worked up into insulating materials and fillers for the paper and similar trades.

THE development of the Frood and Frood Extension nickel-copper mines of the International and Mond companies at Sudbury, Ontario, is being pressed on, and a new smelter unit, with a capacity of 1000 tons, is being built at Copper Cliff to handle the ore which the mines will produce. The smelter is to be ready in 1929.

THE Kimberley concentrator at Nelson, British Colombia, which works on the silver-lead-zinc ore of the Sullivan Mine, said to be the largest mine of its kind in the world, is to be extended so as to be capable of dealing with 6000 tons of ore a day. The plant will also include apparatus for producing 35 tons of sulphuric acid a day from pyrites, and it is proposed to include the manufacture of phosphate fertilisers.

AN article in the *Marine Review* records that some geared turbine machinery was imported into Japan for a ship then under construction, but was not utilised until ten years later. In the interval the great earthquake of 1924 had destroyed all the drawings and some of the smaller fittings. The Japanese engineers, nevertheless, put the plant together satisfactorily without outside help, and the ship sailed 50,000 miles without any hitch.

ACCORDING to a note in the *South African Engineer* concerning a shipment of fifty saloon railway coaches, the Administration has arranged to have each shipped in three complete sections, body, frame and bogies. On arrival at the port, Durban or Cape Town, the bogies will be placed on the lines on the quay, the frames dropped on, and the bodies placed forthwith. The coaches will then be drawn to the workshops for detail finishing. It is hoped to save considerable time in this way. The coaches in question have been built in England.

IN his presidential address to the Warwickshire and South Staffordshire branch of the Association of Mining Electrical Engineers, Mr. F. J. Hopley said that future progress in the use of electricity in mines depended upon the extent to which mining engineers applied their knowledge and experience in the direction of mechanical equipments at the coal face. There were so many problems involved that in future developments the tendency, in his opinion, would be towards the setting up of one central engineering department under a chief engineer, with wide and varied qualifications.

A QUICK repair job was recently carried out at Durban, Natal, on the German liner "Urundi," of 5791 tons, which suffered the loss of one propeller blade and damage to another, through striking what is presumed to have been submerged wreckage about two miles on the Durban side of Port Elizabeth. On arrival at Durban two spare blades which the vessel carried were fitted by James Brown, Ltd., within one day, the cargo being adjusted to expose the propeller boss, while off-loading and coaling were carried on as usual during the course of the repair work, which was completed the same night.

THE development of the Swedish broadcasting service is one of the most interesting chapters in the short but important history of broadcasting. Taking into account its area, and the population living within its boundaries, Sweden must be regarded as having solved the question of establishing a public broadcasting service in a remarkably satisfactory way. Broadcasting started there in the autumn of the year 1923, with one small 500-watt station of Western Electric type 1-A ; during 1926, as many as 27 stations, involving the use of 6000 kiloms. of open wire line for simultaneous broadcasting purposes were in operation.

THE latest tin output statistics for the Dutch East Indies, which contributes approximately 23 per cent. of the total world output of tin, and next to Malaya is the world's largest individual producer, reveal a serious decline in production for the first eight months of 1928. For the period January–August, 1928, the total output was 22,367 tons, against 24,203 tons for the same period last year, a decrease of 1836 tons, or 7·6 per cent. of last year's production. This decrease has taken place although production in all other tin-producing territories shows a considerable increase this year. In the opinion of an eminent British geologist, this decline in the Dutch East Indies output is the beginning of the gradual exhaustion of this important area. According to his report the Dutch East Indies tin deposits, which constitute a monopoly of the Dutch Government, are only sufficient to last another ten or twelve years at the present production rates.

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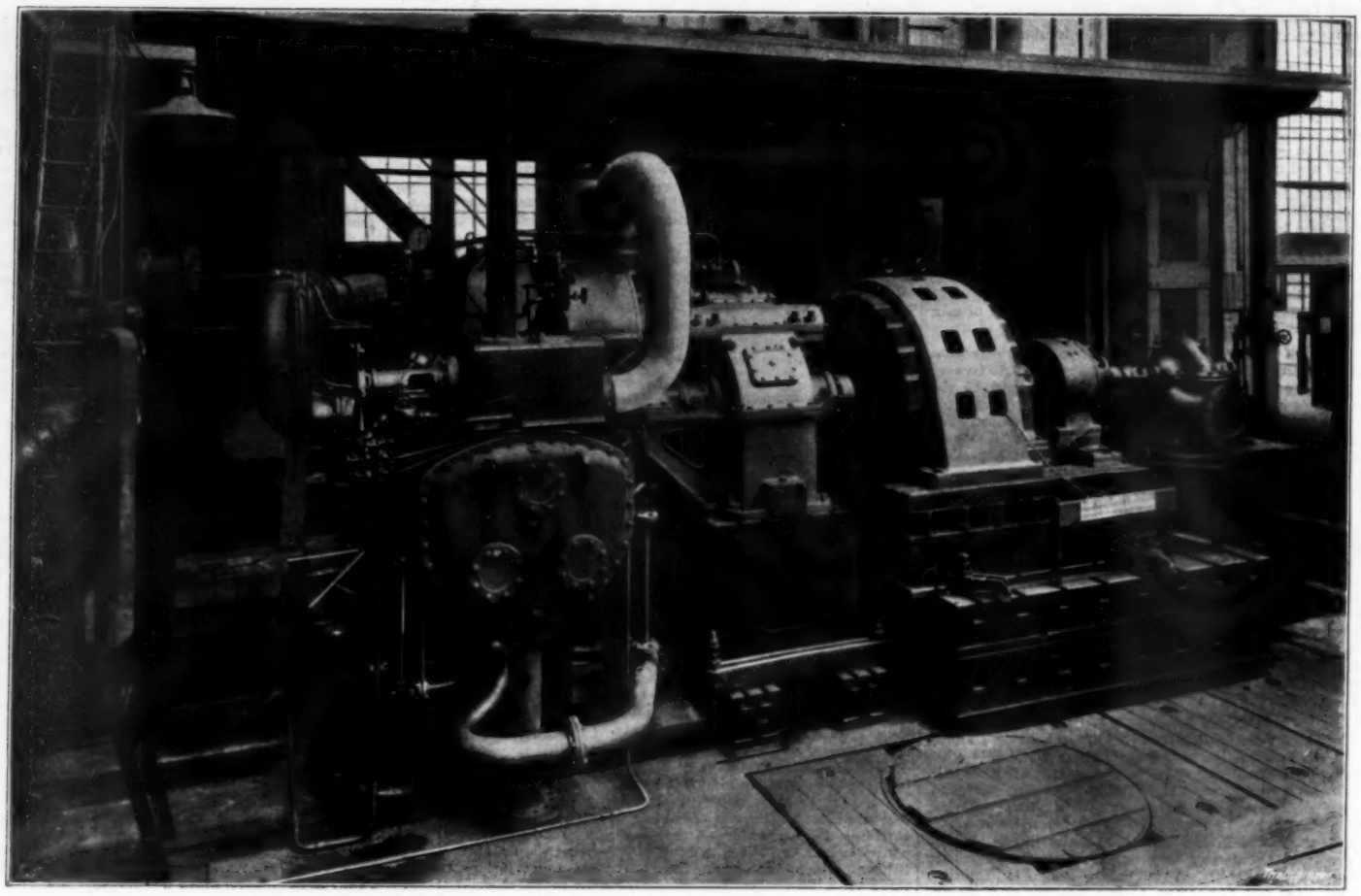
(*For description see page* 365)



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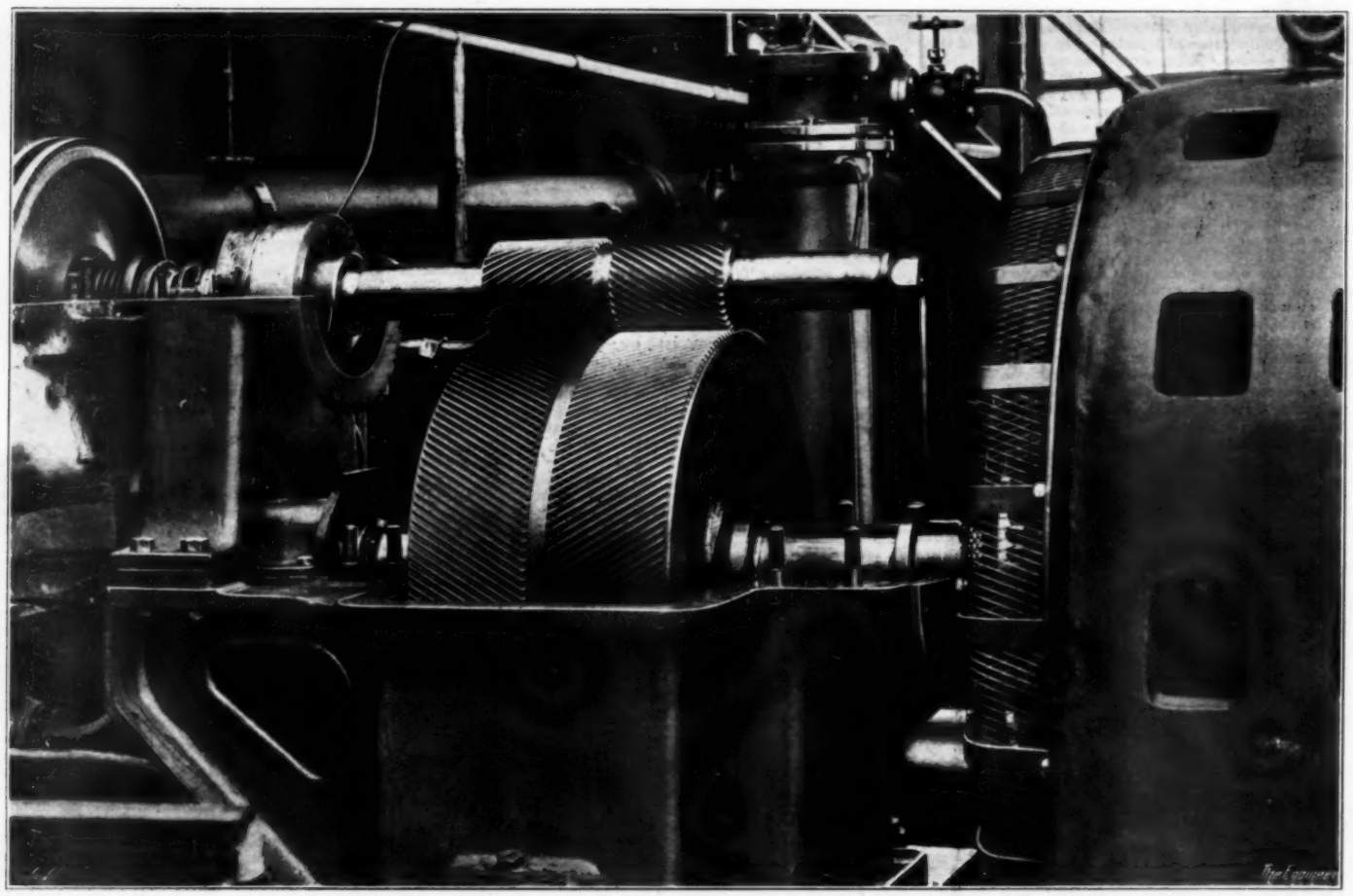

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OCTOBER 5, 1928.

The Limitation of Naval Armament.

ALL intelligent people in this country recognise the importance that attaches to our political relations with the United States. In their own interests and equally in those of the world at large it is most desirable that the two great English-speaking commonwealths should live together in friendship and mutual understanding. Both desire, above all things, the maintenance of peace, a cause for which both have made considerable sacrifices. Between two active, virile communities, each depending for its prosperity on trade, it is inevitable that there should be keen competition in every market to which their products penetrate. But the fact that the Americans are among our most formidable rivals in the realm of commerce need not, and does not, prevent us from being good friends with them. With one exception there is no political problem of major significance in regard to which the Cabinets of London and Washington are at variance. That exception is, of course, the question of naval power and we do not hesitate to admit its great importance. Year by year it exerts an adverse effect on Anglo-American relations, and undoubtedly will continue to do so until the problem is solved. That it should have resisted solution for so long does not redound to the credit of British or American statesmanship. There is nothing obscure about the issue itself or the principles it involves. Ten years ago America came out of the war with a newly conceived determination to possess a navy second to none. Whatever the motives that may have actuated her in that matter, no sensible person believes them to have been bellicose or aggressive in intent. The statesmen then in control at Washington may have thought that a very powerful navy would be the most effectual agency for the support of their policies, foremost among which was the stern discouragement of war tendencies in Europe and elsewhere. It has, indeed, been acknowledged that President Wilson favoured the creation of a formidable fleet because he held it to be a most potent form of moral suasion Another motive, obvious and avowed, was the desire to secure American trade from interference in the event of a future conflict in which the United States might be neutral. It was felt, and doubtless with reason, that the rights of neutrals would command greater respect if backed by an imposing array of naval strength. In recent years it has been openly stated by influential Americans that never again will their country tolerate the restrictions which the Allies placed on American overseas trade before the United States entered the war. The fact that America herself, on becoming a belligerent, not only endorsed the existing arrangements for the control of neutral shipping, but even advised that they should be made more stringent, is apparently regarded as irrelevant. Finally, there is at Washington, perhaps, a not unnatural wish to gain the prestige and world-wide political influence which possession of a navy of the first magnitude would confer.

To none of these motives can this country take exception. We have never questioned America's right to build a navy equal in strength to our own. On the contrary, both before and during the Washington Conference Great Britain formally accepted the American claim to equality on the seas. This principle was duly embodied in the Five-Power Limitation Treaty. Unfortunately, the Americans have all along placed their own interpretation on the principle in question. Not content with securing recognition of their claim to naval co-equality, they are apparently determined to dictate what the future strength of the two navies shall be. This might be well enough were the naval requirements of the British Empire and the United States identical both as to scope and urgency, but they are not. But for her stake in foreign trade the United States would be virtually independent of the sea, while her geographical remoteness from Europe and Asia renders her all but invulnerable to attack. In these circumstances it cannot be pretended that her naval needs are anything like so vital or so extensive as our own, and therefore it seems only reasonable that this country should be consulted before any attempt is made to establish a common denominator in respect of naval tonnage. However anxious we may be to oblige America, we cannot go to the length of accepting a demonstrably inadequate quota of cruiser tonnage. When the Five-Power ratio was first mooted British opinion assumed that American naval strength would be brought up to the British level. Nobody on this side ever dreamed that we should be expected to reduce our strength down to the American level, yet that, in effect, is what we are now invited to do. For reasons too well known to need recapitulation, the Washington Conference attempt to ration cruisers and smaller craft did not succeed. It was revived last year at the Geneva Three-Power Conference, only to fail again. In America the entire blame for this second failure has been laid on British shoulders, though the records of the assembly tell a different story. Great Britain went to the Geneva Conference with a clear-cut programme of naval retrenchment. She proposed a reduction in the size of all future fighting vessels, from capital ships to submarines, and the prolongation of their effective "lives" in order to defer to the very last moment their replacement by new tonnage. This plan offered a practical means of restricting the further development of naval armament, and of effecting very large economies in the future defence budgets of the various Powers. Yet, strange to say, it was opposed from the first by the American delegates. They declined to discuss any reduction in the needlessly high standard of battleship and cruiser dimensions established by the Washington Treaty; they would not consent to any differentiation between large and small cruisers, and they rejected the aggregate of cruiser tonnage which Great Britain put forward as the minimum consistent with her requirements for the defence of her vital trade routes. A complete deadlock was reached when America announced her intention of building nothing but 10,000-ton, 8in. gun, cruisers. She would, it appeared, be satisfied with twenty to thirty of these ships, but to us, with our far greater responsibilities at sea, that number would have been quite insufficient. Consequently we proposed that the number of these very big cruisers should be limited to thirteen each for ourselves and America, and that all cruisers built thereafter be of lighter tonnage and armament. This suggestion was turned down on the unconvincing grounds that ships of anything less than 10,000 tons were "useless" to the United States. In face of this attitude agreement became impossible and the Conference broke up. But the British Government, at least, did not relax its efforts to discover a formula which should satisfy American claims without endangering

our own security. At a meeting of the Preparatory Commission on Disarmament at Geneva in March last, Lord Cushendun tabled proposals aiming at a reduction in the size and cost of battleships and an extension of their life from twenty to twenty-six years. Although American opinion still remained hostile naval circles in Japan welcomed the plan as "honest practical, and capable of forming the groundwork of an agreement which will substantially relieve the taxpayers." At about this time naval conversations began with France in the hope, as Sir A. Chamberlain announced subsequently, "of finding some compromise upon which we could both agree and which we might then submit to other Powers and perhaps facilitate progress in the Commission." These conversations were successful in adjusting the main points of difference between this country and France. The actual text of the compromise has yet to be published, but its substance is now well known. France has accepted the formula of limitation by ship classes, rather than by total tonnage—the method previously favoured by her, and has further adopted the British thesis of non-limitation in respect of small cruisers. Great Britain, on the other hand, has agreed to exempt coastal submarines from limitation on the ground of their being mainly defensive in function.

It cannot be said that this compromise is satisfactory. Those who negotiated it must have known that no scheme of naval disarmament which failed to restrict the building of small cruisers and submarines would stand the faintest chance of acceptance by the United States. Moreover, the elaborate mystery in which the affair has been enveloped has had an undesirable effect both at home and abroad. America's response was not long delayed. It has come in the form of a Note which flatly rejects the Anglo-French compromise as a basis for discussion and reiterates the American demand for big cruisers. The United States, it adds, "cannot consent to proposals which would leave the door wide open to unlimited building of certain types of ships of a highly efficient combatant nature and would impose restrictions only on types peculiarly suitable to American needs." Finally, the Note contains what may prove to be a helpful suggestion. After emphasising America's continued interest in the naval limitation movement, it promises sympathetic consideration for a proposal—provided it comes from Great Britain—to permit any of the Powers to vary the percentage of tonnage in classes within the total tonnage, a certain percentage to be agreed upon. An increase in one class of vessels would, of course, be deducted from the tonnage to be used in other classes. We take it that Great Britain, for example, would be free to build additional cruisers, but only on condition that this excess tonnage was balanced by a corresponding reduction in the tonnage aggregate of destroyers, submarines, or other craft. There are possibilities in this idea which will doubtless receive the careful consideration of his Majesty's Government. But much depends on whether America is willing to abandon her implied claim to determine the future strength of the British Navy, for that is what her policy at Geneva amounted to. Should she persist in that course it is hard to see how further progress in naval limitation is to be effected.

The Callendar Equations and the Critical State of Steam.

The Callendar equations, which provided the first thermo-dynamically consistent system of expressing the properties of steam, have long been recognised as of first-class importance. They are as attractive by their simplicity of form as by the clearness of the ideas which underlie them. The Callendar equation of state, it will be remembered, differs only from the classical $PV = RT$ of the perfect gas, by taking into account the fact that steam, unlike the perfect gas, is composed of molecules. Since the molecules themselves are incompressible, that part of the total volume occupied by them can be subject neither to compression nor expansion. Furthermore, since the molecules have a habit of clinging together in pairs, particularly when the steam is dense, the total volume will be less than that which Avogadro's law would indicate. Nothing would seem more logical than these conclusions, and the equations were further justified by the fact that at all ordinary temperatures and pressures, they expressed the properties of steam with very great accuracy. At very high pressures, however, they became more doubtful, and it had to be admitted that, at the critical pressure of about 3200 lb. per square inch, they failed to represent what was thought to be known about the behaviour of steam. The ordinary theory as to the critical state of steam is very simple. If water is heated in a closed vessel, the pressure of the steam formed will rise with the temperature. As the pressure rises, the steam, of course, becomes more dense, and simultaneously the water, expanding by the heat, becomes less dense. It is evident that there must come a time when the density of the steam becomes equal to that of the water, and since both water and steam are of necessity at the same pressure and temperature, there will be no difference between them. The whole boiler will then be full of a homogeneous substance which may be regarded either as steam or water. At any higher temperature, the substance has definitely the properties of steam, and liquid water cannot exist, however great the pressure. This fact has been turned to account in the Benson boiler, in which there is no "steam space" at all, the water fed into the boiler being given the properties of steam by heating it at a pressure exceeding 3200 lb. per square inch.

Numerous experiments have been made by heating water in sealed transparent tubes of quartz, and it is generally agreed that when the temperature rises to 374 deg. Cent. the critical point is reached. The meniscus of the water surface vanishes, and there is no longer any clear demarcation between what was water and what was steam. It seemed to follow logically that at the same point the latent heat of the water must have also vanished, for latent heat was known to diminish steadily with increases of temperature and pressure, and there was apparently no room for it at all when the transition point between water and steam was attained. So far everything seemed clear, and if the Callendar equations would not agree with the properties of saturated steam at the critical point, so much the worse for the equations. Nobody doubted that, in fact, at the critical point—that is to say, at the temperature at which the meniscus disappeared—the densities of the water and of the steam had become equal, and the latent heat had vanished. Professor Callendar has now, however, carried our knowledge of what really happens at the critical point very much further, and incidentally has confirmed the fact that his fundamental equations for adiabatic expansion, for the total heat of water and the total heat of steam, hold true for the critical region without any modification, and, further, that his equation of state, when the higher degrees of co-aggregation are taken into account, is capable of representing the critical phenomena with much greater accuracy than any equation of the Van der Waals type. The account of his work in this direction is to be found in a paper, entitled "Steam Tables and Equations Extended by Direct Experiment to 4000 lb. per square inch and 400 deg. Cent.," presented to the Royal Society on August 8th last. It has now been published in the "Proceedings" of the Society, where for so many years his original equations lay interred, unknown to engineers to whom they would have meant so much. With improved apparatus on a larger scale, using very pure water free from air, he found that although the meniscus vanished at 374 deg. Cent., the densities of the water and steam did *not* become equal. A visible difference in density persisted beyond this point, and could be traced up to nearly 380 deg. Cent. It appeared that the densities would not become equal, nor would the latent heat vanish before the temperature of 380 deg. Cent. had been slightly passed, although at any temperature above 374 deg. the liquid and vapour were capable of mixing in all proportions.

Professor Callendar concludes his paper by the remark that "the chief interest of these results for steam engineers is that the properties of steam can be represented by comparatively simple equations exactly consistent with the adiabatic equation $P/T^{\frac{1}{2}} = \text{constant}$, even at the critical point, which had previously been considered impossible according to the universally accepted theory of the critical state. It follows that the formulæ previously given for the adiabatic heat drop, and for the discharge through a nozzle, can be applied with confidence in all cases for dry steam." He further remarks that his equation for total heat of steam is equally valid, and that all the relations given by the equations are simplified by the discovery that the small constant, representing the irreducible size of the molecules, is more than five times smaller than previously supposed, and could therefore often be neglected. This latter fact may be comforting, but it is likely to be disconcerting to those who have used the original value in the calculation of tables. The new expression for the co-aggregation of the molecules has been employed in the calculation of extended steam tables up to 4000 lb. per square inch, which have been forwarded to the British and Electrical Allied Research Association, the body primarily interested in the investigations, and mainly responsible for them. All steam engineers owe a debt of gratitude to this Association for its endeavours to put our knowledge of steam on a sound basis, and the assurances of Mr. I. V. Robinson and Mr. George Orrok, at the Fuel Conference last week, that agreement would be arrived at between British and American investigators before a new set of steam tables was published in either country, holds out hopes that very shortly the question of the properties of steam will be settled internationally for once and for all.

Obituary.

SAMUEL TWEEDALE.

Mr. Samuel Tweedale, whose death occurred on the 26th ult. at his home, Santridge, Castleton, near Rochdale, at the ripe old age of eighty-two, was a remarkable man of a type which is fast becoming obsolete. He was a pioneer in the textile machinery industry, and a man of shrewd character. A native of Rochdale, he was one of the founders of the firm of Tweedales and Smalley, Castleton. He served his apprenticeship in the workshop of John Bright Brothers' mill, and started business thirty-seven years ago in partnership with his brother, Mr. Edmund Tweedale and Mr. Joseph Smalley, who were both managers of works at Accrington. Although they made only a modest commencement, the firm thrived so rapidly that it became one of the largest firms of textile machinery makers in the country, employing between two and three thousand persons. Its principal products are machines for opening, preparing, spinning and doubling cotton. Mr. Tweedale was personally responsible for many inventions in connection with roving and spinning frames, and only retired from active work about eight years ago. In 1920 the business changed hands and was formed into a limited liability company. Mr. Tweedale had few interests outside engineering, but he will be missed by a very wide circle of friends in Lancashire.

SIXTY YEARS AGO.

To those seeking information concerning the origin of existing institutions or the development of modern customs, our issue of October 2nd, 1868, should be found of considerable interest. We may note in the first place a paper presented at the quarterly meeting of the North of England iron trade by Mr. J. Jones, secretary to the Trade, entitled "The Position of the Iron Trade in Relation to Technical Information." In this paper Mr. Jones emphasised the urgent need for the organisation of some means whereby British iron masters might be able to acquire speedy news of any development likely to affect their work. He suggested that a society should be established consisting of individual members of the iron trades and of those intimately associated with it, and that this society should meet once a year in some iron-making district for the reading of papers, the interchange of opinion, and the visiting of works. In short, he proposed "the establishment of an Iron or an Iron and Steel Institute." The suggestion bore fruit, and in the following year our existing Iron and Steel Institute was founded. The geography of London was changing rapidly, although no doubt less rapidly than it is to-day. One notable undertaking then in hand was the erection of the block of Government buildings which to-day houses the Foreign Office and the India Office. To secure room for these buildings a number of "filthy streets and wretched houses," including Fludyer and Crown-streets with their courts and alleys, were cleared away, and one side of "imperial Downing-street" itself was taken down. We gave a detailed description of the new India Office and concluded it by expressing the opinion that in the construction of its roof the architect, Mr. Digby Wyatt, had given us the best example extant of the use of iron in ornamental architecture. Another huge building with which the modern Londoner is familiar had also just been completed and opened, namely, the Midland Railway's St. Pancras Station and hotel. Again, the Metropolitan District Railway Company's line from what is now Mansion House Station to Hammersmith was rapidly being finished, and in three or four months time was expected to be ready for traffic from Westminster westwards. The works on the Thames Embankment, including the company's station at Charing Cross, had been begun and it was expected that rapid progress would be made with them. Finally, we may note that from and after October 1st the Board of Trade required all railway companies, except the Metropolitan, to provide smoking compartments for each class of passengers in every passenger train consisting of more carriages than one of each class.

BOOKS RECEIVED.

Electrical Substations. By H. Brazil. London: Edward Arnold and Co., 41, Maddox-street, W. 1. Price 12s. 6d. net.

The Cleaning of Coal. By W. R. Chapman and R. A. Mott. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 42s. net.

Strain Energy Methods of Stress Analysis. By A. J. Sutton Pippard. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 14s. net.

Prospectus of University Courses in the Municipal College of Technology, Manchester, Session 1928–1929. Manchester: The Municipal College of Technology.

The Iron and Steel Institute in Spain.

No. II. (*Conclusion*).*

Stopping in Paris on Friday night, September 21st, the members of the Iron and Steel Institute, with a number of ladies, reached San Sebastian late on Saturday, making the last part of the trip, from Irun, in a special train provided by their Spanish hosts. Sunday was a day of strong sunshine and cold winds, and the famous seaside town, with its twin bays and mountainous background, looked delightful in the clear air. After the President and several members of Council had been graciously received by Queen Ena and Queen Maria Cristina at the Royal Palace of Miramar, the whole party assembled at the Provincial Government Buildings, where a welcome to the Institute was offered by the Provincial Government of Guipuzcoa. Then a drive through the town and a long ascent brought the visitors with their Spanish hosts to a large restaurant on Monte Igueldo, which overlooks the southern bay, with the little island in its centre. After luncheon a group of boys gave an admirable exhibition of Basque folk dancing. The party then split up, some to see a bull-fight and some to see the national game of pelota. At 9.30 an excellent dinner and dance was given in the Grand Casino by the Provincial and Municipal Authorities, and the works of the Province.

Early on Monday, in beautiful but cold weather, a start was made by road for Bilbao in a number of char-a-bancs. Some went by the famous coast road, the Route des Corniches, whilst others travelled through the mountains *viâ* Tolosa. The second group stopped at Beasain to visit the works of the Compañia Auxiliar de Ferrocarriles. Here the casting of steel ingots was witnessed and the whole process of making forged and rolled steel wheel centres for railway material was seen. The two parties joined at Azcoita for luncheon at the Hotel Isabel II., and to pay a brief visit to the monastery of St. Ignatius Loyola. The next stop was at Eibar, a hearty little town where cottage industries are carried on, and where all the people looked extraordinarily happy and healthy. Here the works of F. Agustin Larrañaga were inspected, and many visitors bought examples of artistic metal work which is made by hammering gold wire into incised steel. The works of Eimar flourished at one time on the small-arms trade, but now that it has fallen away a great variety of small metal products, some artistic, some purely utilitarian, is turned out, partly in factories and partly in the houses of the workers. The works of Larrañaga are not large, but as an example of a modern factory it would be difficult to excel them. The company gave the visitors tea in large gardens, which adjoin the works, whilst the village school boys, under the direction of a choir-master, who proved to be a conductor of high artistic taste, sang Spanish songs with great skill. The whole party left Eimar delighted with the friendliness of the welcome, and arrived at Bilbao in time for a very late dinner.

Bilbao is a busy industrial city and port, surrounded by hills and lying almost at sea level on the river Nervion. It has in consequence a naturally damp atmosphere, and as the sky was overcast during the few days of the meeting, the English visitors found it rather relaxing, and were glad enough when the visits to the iron mines took them well up into the hills, where the air was fresh and invigorating. Admirable arrangements were made by the Spanish hosts, and the visits to the various works and mines, some of which have already been described in our columns, whilst others are dealt with to-day, were much enjoyed.

The opening general meeting was held at the Alfonso XIII. High School on Tuesday morning, September 25th, the chair being occupied by the Civil Governor of the Province of Vizcaya. Speeches in Spanish welcoming the delegates were made by Don Valeriano Balzola, Deputy Mayor of Bilbao; Don Alfonso de Churruca, Chairman of the Reception Committee; and Don Esteban Bilbao, President of the Provincial Council.

The Conde de Zubiria, President of the Reception Committee, who spoke in English, in cordially welcoming the delegates to Spain, said his country had the honour of receiving a visit from the Institute 32 years ago, and the good relations then established made the Spaniards feel very happy when an invitation to hold another meeting in Spain was accepted. The progress made by Spain in the last thirty years was evident in regard to agriculture, shipping, railways, and trade in general. A very big scheme for the improvement of the roads of the country, on which 700 million pesetas were to be spent, would have the effect of placing Spain in a favourable position from a tourist point of view. While Spain might be considered as an agricultural country, much capital was invested in the exploitation of raw materials, including coal and iron ore and their transformation. Some of the works were of considerable importance, bearing in mind the small capacity of absorption by the home market as well as the diversity of shapes and qualities. Among the nineteen existing works the most important were Altos Hornos de Vizcaya, Siderurgica del Mediterraneo, Duro-Felguera, Mieres and Nueva Montana, which owned about a dozen blast-furnaces. During their visit the members would be able to judge the importance of the enlargements and improvements being carried out by Altos Hornos de Vizcaya, which were costing several million pesetas, and they would also have an opportunity of inspecting the completely new plant at the works of the Siderurgica del Mediterraneo at Sagunto. It was also worthy of mention that Messrs. Babcock and Wilcox had opened a new engineering works and tube and locomotive factory at Basconia. The works of the Sociedad Espanola de Construccion Naval for the manufacture of guns, turrets and ammunition were of great importance from the point of view of the manufacture of war material in Spain. As it had not been possible to include a visit to those works in the programme of the meeting, he desired to give a short description of the plant. The foundry shop had three open-hearth and five electric furnaces, the former being devoted to the production of mild steel and the latter to nickel and chrome-nickel steel for the manufacture of guns, projectiles, and moulded and forged castings. In the forge shop there were two Davy presses of 1000 and 3000 tons, as well as reheating furnaces, which were able to deal with 30-ton ingots. Every kind of gun element, ship shafts, crank shafts, &c., were manufactured. The necessary furnaces for heat treatment, provided with automatic control of temperature, had also been installed. In the rolling plant there was a 21in. reversible mill specially constructed for rounds and squares intended for the manufacture of projectiles. Two new sheet mills were in course of erection which would allow of the manufacture of special sheets for gun mantelets. The artillery shop had four bays, served by four electric cranes, and was specially devoted to the manufacture of guns, being arranged to give intensive output. The laboratory had all the necessary apparatus for chemical and mechanical tests. All the departments had the most up-to-date appliances and the necessary auxiliary shops and electric power plant. In addition to the four stamping presses already at work, a new one, capable of developing 2500 tons stress, was in course of erection. In the works of the Sociedad Espanola de Construccion Naval at San Carlos the company had started preparations for the manufacture of turrets and guns of heavy calibre. In the Sestao Works, belonging to the same company, the manufacture of submarine Diesel engines was begun six years ago, and fourteen Diesel engines had already been built with an aggregate of 12,800 horse-power. Those works were also specialising in the manufacture of alternating triple-expansion engines.

The output of coal in Spain in 1896 was 1,700,000 tons, while in 1927 the output had increased to 6,860,000 tons. The moderate amount of the increase was due to the enormous development of the hydro-electric resources of the country, which in 1927 amounted to 2,500,000 kW. The output of iron ore had decreased from 5,514,339 tons in 1896 to 4,906,000 tons in 1927, the reduction being due to various causes, particularly the state of affairs in Spain and the condition of the foreign markets. The output of pig iron had increased from 297,000 tons in 1896 to 612,000 tons in 1927, while the output of steel had increased in the same period from 100,000 tons to 600,000 tons. The gross tonnage of the shipping of the country had increased from 485,441 in 1896 to 1,127,037 in 1928. Very great developments had taken place in connection with the use of electricity. The output from the plants actually in operation and in course of construction exceeded 2500 million kilowatts, equivalent to 2500 million lb. of coal; while the capital invested in the industry amounted to 3144 million pesetas. With regard to shipbuilding, Bilbao had always been engaged in the shipbuilding industry, but it was not prosperous until the commencement of the Astilleros del Nervion and Compania Euskalduna. That company had now extended its activities to the engineering industry in general and had produced 79 ships with a total of 143,626 tons, 113 locomotives of from 55 to 110 tons, and 1108 wagons and passenger cars. In 1908 the Sociedad Espanola de Construccion Naval came into being, establishing yards at Ferrol and Cartagena, as well as the important works at Reinosa, where warships, cruisers, submarines and their engines had been built, the total number of ships constructed being 69, with an aggregate tonnage of 148,423, representing 1,161,255 horse-power. As the company desired to develop merchant shipping, it acquired the Matagorda yards at Cadiz, and established the Sestao yards at Bilbao. Up to the present 36 merchant ships had been built with a tonnage of 189,058 and 81,183 horse-power. The company had built altogether 105 ships with an aggregate tonnage of 337,483 tons and a total of 1,242,438 horse-power.

With regard to the railways, several new lines had been constructed, and those already existing had been greatly improved. The length of lines in 1896 was 11,000 kiloms., while in 1927 it was 17,000 kiloms., the tonnage transported during the same period having increased from 16 million to 42 million tons.

He sincerely hoped the stay of the members in the country would be enjoyable and instructive, and he trusted that the holding of the meeting of the Institute in Spain would be for the still greater advancement of that country.

The President (Mr. Benjamin Talbot), in reply, said it was thirty-two years since the Institute paid its first visit to the country, and it was pleasant to find that the visiting members on the present occasion included among their number four of those who were privileged to be present at the meeting in 1896, and who retained the most pleasant recollections of their former visit. Bilbao was an appropriate place for a meeting of that kind, being, as it was, the chief centre of a district where the iron industry had existed from time immemorial. By the Middle Ages the Basque country had become one of the most important iron-producing lands in the world, and in the forges among the hills and valleys there was produced a quality of steel that became famous in all countries. The excellence of the steel weapons exported from Bilbao was attested by the fact that in England, in the days of Shakespeare, the word "bilbo" was a common term for rapiers. The iron from Bilbao was also used for a variety of purposes in our Navy; and, in the days of sailing vessels, if a mutinous sailor was put in irons, it was said of him that he was sitting in the "bilboes." In any case, owing to the skill of Spanish craftsmen and the excellence of Spanish minerals, the direct process, as carried on in the Catalan hearth, yielded a product which was nowhere excelled. Apparently at the height of its prosperity in the eighteenth century the annual production of the Province of Biscay was about 20,000 tons of direct iron. When puddling was introduced about the end of the eighteenth century the industry, he understood, began to suffer from severe competition. He thought Bilbao was a free port and that the Spanish were free traders at that time. Owing, however, to the superiority of their products it would seem that production by the direct method lasted well into the nineteenth century. It was not until 1832 that the first blast-furnace was erected in Spain on the Mediterranean Coast and seventeen years later the first one was built in Biscay. Since then great blast-furnaces, steel works and rolling mills, equipped with every modern device, had been established on the banks of the river and a great new iron and steel works had been built at Sagunto.

He desired to say a few words about the wonderful ore resources of the country, and their relation, not only to the English industry, but to the steel industry of the world. The beginning of the systematic exploitation of those ores coincided approximately with the rise of the Bessemer process. By 1870 some 200,000 tons of ore were being exported annually, nearly all to Great Britain. Unfortunately, the Civil War, which afflicted the country from 1873 to 1876, caused a complete stoppage of exports, but after that the development went on apace, and by 1878 the exports from Bilbao to Great Britain were 903,000 tons. It was in that decade that Bessemer steel rails were introduced, and owing to the great railway developments of that period the demand for Bessemer rails increased so rapidly that, unless the makers had been able to obtain an ample supply of the very pure ores from Bilbao, it would have been impossible to keep pace with that demand. The earliest recorded figures of the production of Bessemer steel rails was 620,000 tons in 1875. By 1880 it was 1,044,000 tons, and in 1890 the production of steel rails in Great Britain had reached 1,720,000 tons. In the paper which Mr. Balzola had prepared for the meeting it was stated that the total quantity of ore already extracted in the Bilbao district since mining operations began was 200,000,000 tons. Practically the whole of that vast quantity of ore had been utilised in the production of steel and represented, therefore, an enormous contribution to the development of the world. The total amount of steel produced from that ore must be more than equal to the world's production of steel in 1927, which was 90,011,000 tons. Those figures gave some idea of the tremendous debt which the world owed to the district of Bilbao as a productive source of iron ore. From 1900 onwards the production and exports of iron ore from Bilbao had greatly declined owing to the approaching exhaustion of some of the better mines. Notwithstanding those conditions the prosperity of Bilbao had by no means declined, and there had sprung up a number of new and prosperous manufacturing industries, for the maintenance and conduct of which the local conditions were well adapted, which circumstance was a just cause for unbounded admiration of the energy and enterprise of its citizens.

The chair was then vacated by the Civil Governor and taken for the remainder of the meeting by Mr. Benjamin Talbot, the President.

The President announced that the scrutineers reported that all the applicants for membership, except one, had been duly elected.

The first paper for discussion was on "Iron Ore Mining in Vizcaya," by Jose Balzola, mining engineer, Bilbao, Spain, which was published in an abridged form in our last number. The paper was read in abstract by the Secretary, owing to the absence through illness of the author.

Iron Ore Mining in Vizcaya.

The President, in inviting discussion, said he thought the paper was an excellent one which would

* No. I. appeared September 28th.

prove of great use to the members of the Institute, as it brought the details connected with the iron ore mining industry in Vizcaya right up to date, and was very complete in every respect.

Don Balzola, the father of the author, who was called upon by the President to open the discussion, expressed his great pleasure at being present at the meeting, and the deep regret of his son that illness had prevented his attendance.

Mr. W. Simons (Cardiff) said that as one who was directly connected with the iron ore industry he had found the paper of very great interest. The author stated that it was supplementary to Mr. Gill's paper, but in Spain, as in all other countries, social changes had occurred and labour costs and taxation had increased, and therefore the old method of working by hand labour as described by Mr. Gill had been supplanted by a system of mechanisation for the purpose of reducing the cost. The author had given a very able description of the changes that had taken place in that respect, on which he desired to congratulate him heartily. He desired especially to call attention to the very interesting chart that was included in the paper, giving details of the production of iron ore. It would be observed that the rise in the output of iron ore coincided with the development of the steel industry in England. It was hardly necessary for him to tell the members that one defect of the Bessemer process was that it could not eliminate the phosphorus, and the only place in the world from which low-phosphoric ores could then be obtained in any quantity was Spain. Although English ironmasters claimed to be pioneers in the production of iron and steel, they were indebted to the enterprise of the mine-owners in Spain for the manner in which they were able to supply England with iron ore during that period. It might be said that after 1900 there was a direct drop in the production, which some people might say was due to the diminished amount of ore available in Spain, but he did not think that was the case. He ventured to say that at that time the basic Bessemer process came into active operation, and therefore there was a much wider field of suitable ore. He desired to place on record, however, that Great Britain was indebted to a large extent to the great assistance it had received from other countries during the early days of the steel industry. From the technical point of view it would be observed that the author had raised a very important point, namely, that the future of the iron ore mines in Spain would be dependent upon supplies of spathic ore. That had been foreseen. Spathic ore was increasing in quantity and it was necessary either to put down additional kilns or to get a larger output from the existing kilns. He confirmed the statement made by the author in the paper that his general manager and the staff were exceptionally successful in the treatment that had been adopted by altering the base of the kilns, the admission of air and the method of discharging, thus preventing the formation of boulders, thereby doubling the output of the kilns. They had thus made a substantial contribution to the success of the industry by showing how the cost of calcining could be materially reduced, a point of great value to all engaged in the industry. Another important point he desired to mention was that it was more difficult to work in a blast-furnace spathic ore containing 2 per cent. of very fine material than to work such an excellent lumpy ore as the Rubio which was obtained in Bilbao. That difficulty had been faced in his own case, as indicated by the author, by putting down a sintering plant. That sintering plant had been operating for about six weeks, the whole of the fines being taken out of the spathic and other ores, and the improvement in the blast-furnace operation had been most marked. The amount of flue dust that was blown out of the furnace had been reduced by 50 per cent., and there had been a gradual improvement in the working of the furnace owing to careful sizing of the material. It was impossible to get good work from a blast-furnace in which irregular material was employed. He had been delighted to receive a cablegram saying that the improvement was so marked that one of the blast-furnaces in operation at Cardiff had produced another record, although it already held the record for the country. The output during the previous week was 3700 tons, which he put down directly to the adoption of the points set out in the paper. All those engaged in the industry would have to take into consideration the great importance of sintering and careful sizing of the material in order to make the most of the fine material that was now on the market.

Mr. F. W. Harbord, C.B.E (Past-President) said, that from his recollection of his previous visit to Bilbao he believed that not a large quantity of washing of the ore was carried out, and he would therefore like to know to what extent the proportion of ore washed had increased during the last twenty years. If the ore was washed it had a very important bearing on its use in English works, and it would be necessary to adopt very much more largely the sintering of the fine ore.

A paper entitled "The Use and Interpretation of the Transverse Test for Cast Iron," by J. G. Pearce, M.Sc. (Eng.), was then presented in abstract. The author's summary of the contents follows :—

THE TRANSVERSE TEST FOR CAST IRON.

The number of variables encountered in foundry practice in the raw materials, in melting methods, and in moulding practice, combined with the range of tests by which strength is measured and the number of standard bars of any one test, have hitherto prevented the correlation of strength with size and of strength with composition, because the connection has been obscured.

It is suggested that by concentration on the new standard cylindrical transverse bar, and by casting bars of varied sizes and compositions, it becomes possible to chart relations between size and strength, and between composition and strength. It is shown that the transverse rupture modulus increases continuously as the test bar diameter diminishes until the point is reached at which the metal ceases to be grey. The size-strength curve is a useful index to the behaviour of cast iron in thick sections, and the composition-strength curve deduced from a series of these promises to be of considerable assistance both to the designer of cast iron structures and to the founder who has to realise the designer's ideas.

The transverse strength is closely related to tensile and compressive strengths, but this relationship is only shown if the transverse strength is expressed as rupture modulus based on the area at fracture. It is hoped that the expression of transverse strengths as rupture moduli will become general.

The change of the rupture modulus with the diameter is so rapid that the use of conversion formulæ to bring a breaking load on a cast bar to a breaking load on a specified diameter may introduce serious errors. If the size-strength curve for a particular mixture and melting *regime* is known, deviations from the specified size can be corrected with much greater accuracy.

In the absence of any discussion, on the motion of the President, a hearty vote of thanks was accorded to the author for his interesting and instructive paper, and the meeting adjourned to the following afternoon.

The second session was held in the Assembly Hall of the Alfonso XIII. High School on Wednesday afternoon, September 26th, Mr. Benjamin Talbot, President, occupying the chair.

The President, at the opening of the meeting, said he was sure the members would desire, as the first business of the meeting, to pass a resolution of condolence with those who had suffered in consequence of the disaster connected with the theatre fire in Madrid. A telegram had been sent to the Spanish Government expressing the condolences of the Institute. All present stood in silence while the resolution was passed.

The secretary announced that in accordance with the articles there had to be submitted to the meeting the names of the Vice-presidents and Members of Council due to retire at the annual meeting in 1929. The names of the Vice-presidents were :—Mr. E. H. Saniter, Colonel Sir Charles Wright, and Mr. Mannaberg. The names of the Members of Council were Mr. Arthur Dorman, Dr. W. H. Hatfield, Mr. V. Beardmore Stewart, Mr. H. Spence Thomas, and Mr. A. O. Peech. All those gentlemen were eligible for re-election at the next annual meeting.

The President said he was sure all the members would be delighted to hear that the Council had elected the Conde de Zubiria as one of the Honorary Members of the Institute. He thoroughly deserved the honour, not only because of the long period of time he had been a member of the Institute, but because of the work he had done for the advancement of the industry.

A paper by A. Herrero and M. de Zubiria (Bilbao), entitled "The Phenomena of Corrosion of Iron and Steel," was then read in abstract.

CORROSION.

Although it would appear that the fundamental problems of metallurgy have been mastered—the most fundamental problem of all still lacks adequate elucidation. Briefly, that problem consists in the study of the influence of the atmosphere in causing deterioration of metallurgical products, or, in short, of the phenomenon of corrosion.

Assuming, as a starting point for subsequent calculations, that the world's annual production of steel is 100 million tons, and that the average life of iron and steel products is thirty years, it means that at the end of that period this enormous production will have been converted into scrap. The scrapping of the greater part will no doubt be due to the fact that the progress of industry necessitates the replacement of many structures or appliances by others more economical or more accurate. But there nevertheless remains a large proportion amounting to millions of tons, the deterioration of which is due to corrosion alone, and when that tonnage is converted into terms of fuel consumed in its production the loss of combustible alone assumes startling proportions.

That the atmosphere exerts a great influence is obvious from the fact that the common metals always occur as oxides, sulphides, sulphates, or carbonates, and scarcely ever as native metal, except those such as gold and platinum, which are not susceptible to atmospheric corrosion. The metallurgist in extracting the metal from its oxide is really exerting himself to undo that which the slow action of the atmosphere has brought about, and although he has found a means of succeeding in this, his triumph is apt to be short lived, since the metal purified with such labour and expense soon tends to revert to the state of oxide, sulphide, sulphate, or carbonate from which it had been extracted.

If the only remedy against corrosion were to be found in the use of special non-rusting steels, the high cost of these would greatly restrict their application. The ordinary steel structures, such as bridges, structural steel for buildings, hulls of ships, railway material, &c., could never be built of such expensive material. The whole problem is a much wider one, and is not capable of so simple a solution. The main point is that any economic solution of the question must be one that will not raise the price of ordinary commercial steels above that at which they must of necessity be sold. It is this aspect of the problem which has been the subject of much study for several years, and upon which much has been written.

The paper then discusses the various theories of corrosion and reaches the following conclusions :—

Causes of Corrosion.—The causes producing corrosion are of two distinct types :

(1) Those which are independent of the object which suffers corrosion.

(2) Those which are a function of the physical or chemical properties of the object.

The first category includes, of course, those causes due to the surrounding medium in which the material happens to be placed, such as the following :

(1) Atmospheric conditions in general.

(2) Degree of contamination of the air or of the water by gases such as carbon dioxide which is very easily dissociated, or sulphur dioxide gas, which has a very intensive corrosive action.

(3) Stray currents from electric circuits of high potential.

(4) Contact with other metals or with ferrous metals of different chemical composition.

(5) Faulty design.

In the second category the following causes may be mentioned :

(1) Local differences of composition due to non-metallic inclusions.

(2) Deposits, local or otherwise, of foreign bodies.

(3) Segregation of metalloids.

(4) Internal stresses or strains.

Means for Moderating the Effects of Corrosion.—Once the causes producing corrosion are known, it becomes possible to consider the remedies that may be applied to avoid it or restrict it within limits. Concentrating first on the external causes, it is outside our power to alter the atmospheric conditions, or to prevent contamination of the air by carbon dioxide or sulphur dioxide gases, which necessarily abound in metallurgical works on account of the combustion of fuel on a large scale therein. Preventive action can only be taken to meet the cases set forth in paragraphs : (3), the attack by stray currents of high potential ; (4), attack due to the use of metals of different chemical composition ; and (5), attack due to defects in design. With regard to Nos. 3 and 4, it is difficult to find an efficacious remedy ; for example, in the case of the metal supports of the transmission lines of high-tension electric current, leakages of current, due to defective insulation, are not infrequent, and are difficult to prevent. Likewise in the manufacture of machinery, contact between different metals giving rise to corrosion is inevitable.

With regard to defective design, it has repeatedly been found that in a steel structure the main components have for the most part been perfectly calculated to withstand the mechanical stresses which they are intended to bear, but that by some error certain principal members have been miscalculated, with the result that the material in parts is stressed beyond its elastic limit. Under such conditions the parts so stressed, which may be very important members of a framework, are highly liable to corrode even though the remainder may remain normal, and thus the stability of the entire structure may be impaired. It has happened that the whole structure has had to be taken down and replaced through failure to recognise this danger.

It has also happened in the case of a structure perfectly designed from the point of view of resistance to the mechanical stresses that rain water may accumulate in hollow spots and remain a long time without draining off, and if such spots are not easily accessible it may not be easy to keep them properly painted or remove any coating of rust which may have formed on the steel structure. All such cases show the importance of the study of corrosion from the point of view of safety, and how the rusting of a small and insignificant part may lead to the destruction of the whole structure.

Concerning the general atmospheric conditions it is evident that a moist air and persistent exposure to rain with strong aeration are agents which particularly favour corrosion, since both the electrolyte and influence of oxygen then come into action.

With regard to the internal causes which stimulate corrosion, it has already been indicated in what direction the remedy should be applied in each case. Proper heat treatment and mechanical treatment, the elimination of impurities and avoidance of segregations, are the principal objects to aim at to obtain improvement. All non-metallic inclusions contained in steel, whether gaseous or solid, are impurities and defects which need never be present if sufficient care be taken in the manufacture of the steel, and the same applies to surface deposits of foreign substances.

It is undeniable that a suitable heat and mechanical treatment will remove strains from steel, and it is equally true that the removal of the segregating metalloids, sulphur and phosphorus, particularly sulphur, will improve the rust-resisting qualities of the metal.

The President, in inviting discussion, said the paper dealt with the most important subject which steel metallurgists would have to face in the future. If our metallurgists and scientific men overcame the present difficulties, the use of steel could be increased indefinitely. The members were aware that a special committee of the Institute was at work on the question of corrosion, and, in his opinion, it had years and years of work in front of it.

Professor Carl Benedicks (Stockholm), in opening the discussion, said that the authors, in their very complete paper, had referred to the famous iron pillar at Delhi. The question arose whether in the tropical climate of India and elsewhere some factor occurred which gave rise to the formation of some protective film. It occurred to him that such a factor might exist in tropical countries, owing to the fact that the rain water contained more nitric acid than in cooler climates, and it had been well known since the end of the eighteenth century that concentrated nitric acid rendered iron passive or non-corrodible. The quantity of nitric acid in rain water was very low, but it might have the effect of producing a protective coating.

Sir William Larke said that, as a member of the Corrosion Committee of the Institute, he welcomed the paper very much indeed, and desired to emphasise its concluding paragraph in which the authors urged upon all metallurgists and particularly the members the desirability of co-operation by exchanging their results and experiences in regard to corrosion. He appealed to all the members to make a point of communicating to the secretary of the Institute any results they might obtain, or any views they might hold with regard to corrosion, in order that the work of the Corrosion Committee might be made of real value to the industry and the world.

Mr. J. Henderson (Scunthorpe), referring to the following passage in the paper—"Moreover, it is a curious fact that as the demand for steel increases and as the capacity for its production on a large scale is ever growing, the relative amount annually wasted by corrosion also increases ; that is to say, with more intensive manufacture, the inferiority of the product with respect to its resistance to corrosion appears to be on the increase"—said that he hesitated to challenge the considered opinion of the authors of such an able paper, but he desired to say, as a practical man with many years' experience in the manufacture of steel in England, that he could not subscribe to the truth of the paragraph he had quoted so far as his experience went. He felt that during the past twenty-five years there had been

a very steady increase in technical development and that a product was now being produced which was very much freer from impurities of a metalloid character, such as sulphur and phosphorous, and also from the oxides and other inclusions which were always present to a greater or less extent. Corrosion, as the authors stated, whether it be due to the electro-chemical or the pure chemical theory, centred round those impurities, and he thought it must be admitted that there had been a steady improvement in that respect, at any rate, so far as his own experience in England went. Although it was not clear proof of his conviction, he knew that for several years past in the works with which he was connected experiments had been made with steel containing a small percentage of copper, which was much used in the United States and elsewhere for the purpose of reducing the rate of corrosion, and the results so far obtained had been entirely negative, *i.e.*, the copper steel had not given any better results than the other steel. He felt that at the present time a higher quality of steel, particularly in the Siemens Martin process, was being made than previously, and that to that extent a steel was being produced that would last longer and that would be less subject to corrosion.

M. de Zubiria (Bilbao), in reply, thanked the members for the great attention with which they had listened to the paper, and particularly those who had discussed it. He proposed to reply to the discussion in a written communication.

Only one other paper was taken. It was written by the Rev. Joaquin Orland (Madrid), and was entitled "The Influence of Pearlitisation below the A_{R1} Point on the Mechanical Properties of Carbon Steels." The only speaker in the discussion was Dr. Benedicks.

The meeting concluded with votes of thanks to the numerous Spanish hosts of the Institute.

VISITS (continued).

The Orconera Iron Ore Company.

The Orconera Iron Ore Company, of Bilbao and Santander, is an English Company, and its existence dates from 1873. Its head offices are in London. It was established to work a group of mines in the province of Biscay, which were secured on a ninety-nine years' lease. The mines are in the Somorrostro Hills at about 340 m. above sea level. The ores descend by inclined planes to a double line of railway built by the company and are hauled to Luchana on the river Nervion, where the company has three shipping berths, and are sent to Guest, Keen and Nettlefolds, Ltd., Cardiff; the Consett Iron Company, Ltd., at Consett, Durham; and to the Sociedad Altos Hornos.

The company owns in all about 5,000,000 square metres of mining properties. For many years only brown and red hematites—Rubio and Campanil—were mined, but at the end of last century large deposits of carbonate of iron were proved and calcining kilns were erected for the production of calcined spathic ores. At the present time the output is about 1500 tons per day from twelve kilns.

During the earlier years of the development of the property only lumpy ores could be sold to blast-furnace proprietors, and by 1910 many millions of tons of small and mixed Rubio ores had accumulated in the dumps. In daily working, too, small and lean Rubios occur. The company decided to turn this wasted material to account and therefore erected a double aerial ropeway (Bleichert) from the Matomoros mines to the washing mill at Povena overlooking the Bay of Biscay, and nearly 8½ kiloms. distant. Here the ore clays are washed and concentrated at the rate of some 700 tons per day. The washed ore is sent back in the ropeway buckets to the company's railway line at Gallarta.

The annual production of the three classes of ores from the Orconera mines is now about 850,000 tons.

In 1896 the company leased an important group of mines at Obregon, in Santander, and in 1919 purchased the property of the San Salvador Company adjoining Obregon. The Santander mines contain ore clays which yield, after washing, between 20 per cent. and 35 per cent. of clean ore, of which the iron content is some three or four units higher than that of the Bilbao Rubios and washed ores, although of inferior mechanical condition. The Obregon and San Salvador mines are in the Cabarga mountain, about 9 kiloms. from the Bay, with which they are connected by a narrow-gauge line. After washing the ores are sent to the shipping staithes at Astillero, which can handle between 400,000 and 500,000 tons a year. The output is at present about 200,000 tons per annum, but is to be considerably increased.

Two illustrations of the company's properties are given on this page.

Orconera Iron Ore Mines—Head of Main Incline

Orconera Iron Ore Kilns

Compania Anonima "Basconia."

This company was formed on November 30th, 1893, with the manufacture of tin-plate as its sole object.

The company's field of activity was first widened in 1900, when the production of the raw material was begun in Siemens-Martin steel furnaces. Rolling mills were then put down for the manufacture of hoop and bar iron, standard sections, wire rod, &c. These extensions were completed in the year 1902. Constructional workshops were built in 1906, and rolling mills for heavy and light plate were installed in 1916. Finally, in 1918 the company's facilities for the production of tin-plate were increased by the addition of further trains of rolls for this purpose.

The works are situated about 5 kiloms. from Bilbao, on the left bank of the river Nervión, in the district of Dos Caminos, Anteiglesia de San Miguel de Bassuri. The company owns three waterfalls situated near it, industrial plants, and also bituminous and semi-bituminous coal mines in the León valley (Puente Almuhey).

The works are served by the following railways:—Ferrocarriles Vascongados, metre gauge; Ferrocarriles Santander–Bilbao, metre gauge, two branches; Bilbao–Durango Tramway, 1·46 m. gauge; Ferrocarril del Norte, standard gauge. There is also a main road connection between the works and the Bilbao–Pancorbo road. All these means of communication run right into and through the works, serving each of its departments, and placing them in direct communication with the outside transport systems.

Steel Furnaces.—There are four Siemens-Martin basic steel furnaces, each of 25 tons capacity. Two charging cranes of the jib type and 2·5 tons capacity, and an auxiliary carrier of 5 tons, convey the charges of pig iron and scrap from the scrap ground, in containers resting on small tables. Besides these, there are one 40-ton tapping crane with auxiliary hoist of 5 tons; one 5-ton travelling crane at the same level; one 5-ton semi-portal crane at a lower level; one tapping carriage.

The furnaces are fed by eight gas producers—two for each furnace—which are 2·6 m. in diameter, with mechanical grates, and fed by a special charging crane.

The scrap ground is 200 m. long by 30 m. wide, and is served by a crane with an 8-ton lifting magnet for loading and unloading pig iron, steel scrap, &c.

Foundry.—Adjoining the furnace department there is a steel and iron foundry, which contains two cupolas, two travelling cranes, &c., and is employed on general repair work for the factory and a certain amount of outside work. There is also a pattern shop in connection with the foundry.

Rolling Mill.—This department contains three three-high housings with rolls 750 mm. in diameter. The first is a roughing mill with elevator tables, and the other two are finishing mills fed by "aviots," the whole being driven by a 1300 H.P. steam engine. This mill has rolls 2·2 m. long for turning out hoop and bar iron, blooms, rounds and girders of plain, tee and channel section; a shears, an electrically driven saw, and three pulverised coal re-heating furnaces complete the equipment.

The roughing mill consists of two housings with rolls, 500 mm. diameter and 1·6 m. long, for rolling standard section girders, tees, channels, rounds and squares. This mill is driven by an 800 H.P. steam engine, and there are two re-heating furnaces, using semi-gas.

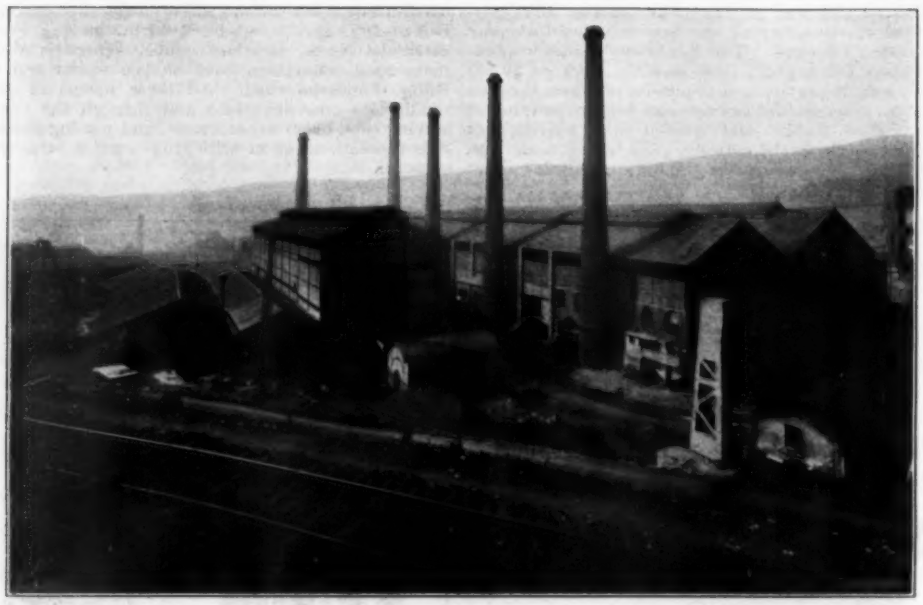
There are two wire mills with three-high housings, with rolls, 200 mm. diameter and a length of 1 m. in the case of the first, and 600 mm. in that of the second. This mill turns out rounds, squares, strip, and other small sections.

There is also a continuous wire rod mill consisting of nine housings, with rolls 240 mm. diameter by 500 mm. in the case of the earlier and 600 mm. in that of the later passes. In this mill rounds from 5 mm. to 12 mm. in coils weighing approximately 50 kilos. each, are rolled. This mill is driven by a 1000 H.P., three-phase, alternating-current motor, and by the steam engine mentioned above. The same re-heating furnaces are used with it as with the roughing rolls.

Machines for the finishing and cutting of sections, &c., are located next the constructional workshops.

Plate Rolls.—This department contains a train of heavy plate rolls of the "Lauth" type, in which plate of 3 mm. to 25 mm. in thickness is rolled in widths up to 1·5 m. and lengths of approximately 12 m. The upper and lower rolls are 630 mm. diameter and 1·7 m. long. The centre roll is 480 mm

diameter by 780 mm. long. Coupled to this mill is a two-high stand for the making of ribbed plate. This mill is driven by a 1500 H.P., three-phase motor,



BASCONIA STEEL WORKS

with a 65-ton fly-wheel, which also drives thin plate rolls coupled to the same shaft through reducing gear.

For the cutting of heavy plate two powerful shears are provided capable of cutting up to 30 mm. thickness. These are served by a travelling crane of 5 tons capacity.

Two re-heating furnaces for thick plate, and one for thin plates, and one annealing furnace—all of them fired from two gas producers with fixed grates and mechanical stoking—are provided.

A 3-ton crane for charging the re-heating furnaces and a 15-ton travelling crane for changing the rolls, serve the above-named machines.

Tin-plate Department.—This department contains thirteen "Galeses" mills, as follows:—Three 26in. mills, driven by a 300 H.P. turbine; one 22in. and two 26in., driven by a 200 H.P. steam engine supplied from marine type boilers using pulverised fuel; two 26in. and one 28in. and one 30in., driven by a three-phase motor of 830 H.P., with a fly-wheel weighing 80 tons; two 28in., driven by a 400 H.P., three-phase motor, with 50-ton fly-wheel; one 28in. and one 50in. for turning out fine 2 by 1 plate. Both these mills are driven by an electric motor of 630 H.P., with 50-ton fly-wheel. There is a series of re-heating furnaces for all hot rolls, some grate-fired, the most modern using producer gas.

The following equipment is also to be found in the works:—

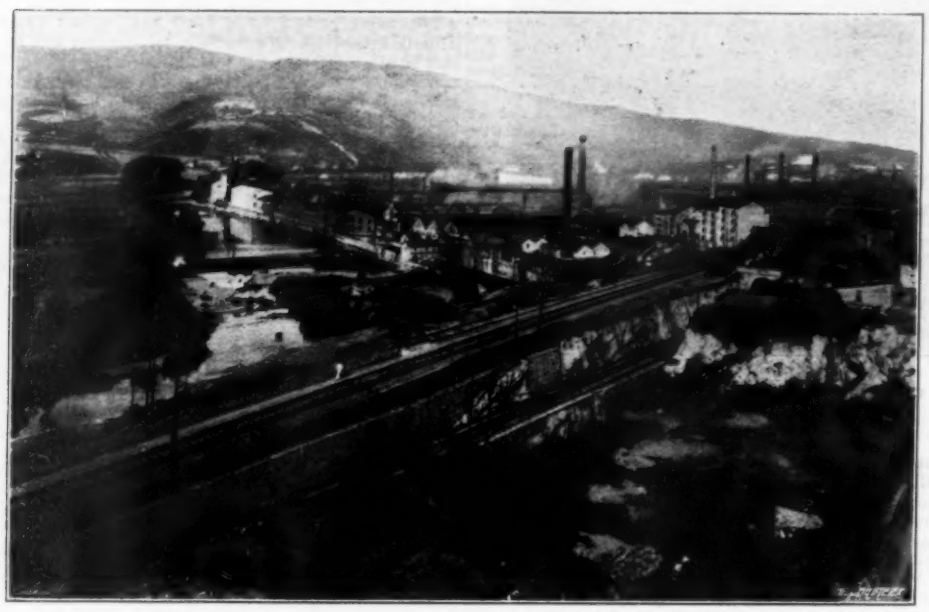
Cold Rolls consisting of six housings and used for the planishing of plates. Driven by a 250 H.P., three-phase motor, with 25-ton fly-wheel.

Annealing Plant.—Five gas-fired furnaces, with four fixed grate gas producers, grab cranes for introducing the charge, and a 5-ton travelling crane. Three steam-heated pickling baths for cleaning the plates.

A Disc Department containing six cutting presses, each provided with a complete set of dies for the manufacture of discs of various diameters.

A Bucket Department, containing a complete and modern equipment adequate for an annual production of 500,000 pieces.

A Shovel Department, containing all the machinery—such as presses, lathes, &c.—for cutting the plate and working the wood is installed, suitable for turning out annually 300,000 articles.



BASCONIA WORKS—GENERAL VIEW

A Structural Steel Shop, of three bays, each served by a 10-ton travelling crane, and equipped with every kind of modern machinery, such as riveters, planers, punching machines, plate-bending rolls, &c., with an annual output of 5000 to 6000 tons; erecting and setting-out spaces, &c.

Central Electric Power Station.—In this station there are two Babcock and Wilcox boilers, with 350 square metres heating surface and mechanical grates and stokers, which supply superheated steam to turbo-alternators of 1500 kW and 5000 kW, built by Brown, Boveri and Co.

Two water turbines, with an average power of 500 H.P.

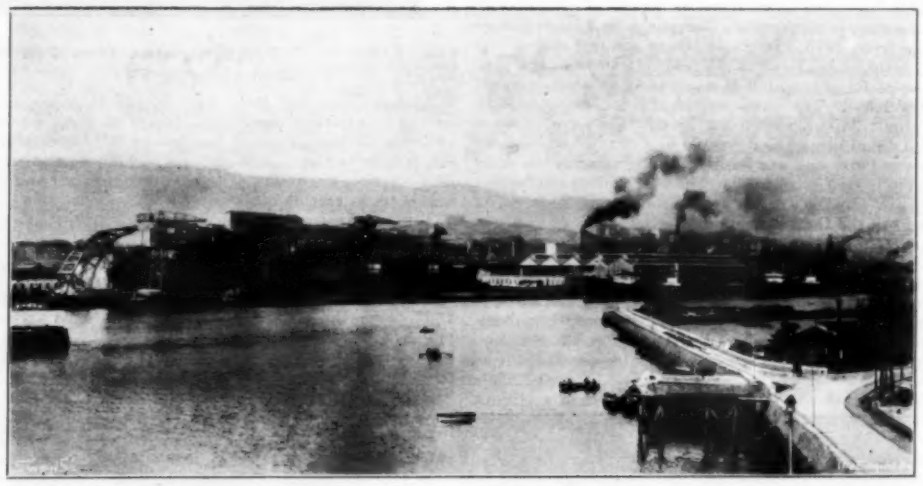
Four Babcock and Wilcox boilers, with 250 square metres heating surface, using pulverised coal, and equipped with Green economisers, which supply the rolling mill engines.

Auxiliary Workshops.—In addition to the above-mentioned shops, there is a series of secondary departments, which may be styled auxiliary workshops, such as:—Bolt and rivet shop, where supplies of these articles are made for structural steel work; machine shop and smiths' shop, which undertake the general repair work and millwrighting of the factory. carpenters' shop; electrical shop, where repairs to electrical plant are carried out; and a refractories department, which prepares part of the furnace linings consumed in the steel furnaces and re-heating furnaces.

A general view of the works and a view of the steel works are given on this page.

Sociedad Espanola de Construccion Naval.

This company owns in Bilbao two works at the mouth of the river Nervion. One, called the Sestao Works, of which we give an illustration, is fully equipped for the construction of passenger, cargo ships and dredgers, and all their machinery and boilers. Here, too, internal combustion engines, especially for submarines, are made. The other works, the Nervion, are engaged in the manufacture of railway material and on general ship repairing.



SOCIEDAD ESPANOLA DE CONSTRUCCION NAVAL SESTAO WORKS

At the Sestao yard there are four slipways, one 200 m., one 160 m., and two 140 m. in length, all provided with four tower cranes, two on each side. At the head of the slips are the usual platers' and joiners' shed, and a smiths' shop. Adjoining the latter is a gun-carriage shop, where at the moment gun-carriages and wagons for the Spanish Artillery are being made.

The machine shop, fitting shop and boiler shop occupy three bays, each 115 m. long by 18 m. wide. They are all well provided with modern tools, some of considerable size. There is a good foundry, but a much larger one, 140 m. by 56 m., is under construction.

The fitting-out wharf has a concrete wall, 450 m. long, provided with tower cranes for moderate weights, heavy pieces being handled by a 100-ton floating crane.

In the Nervion yard there is a dry dock, 140 m. long, around which are placed the appropriate shops.

We may add that the company owns besides these works a naval shipyard at Cartagena, three works in Cadiz, where passenger and mercantile vessels, torpedo boats and artillery are constructed, and a large shipyard at Ferrol, near Coruña, where battleships and smaller war vessels are built. It has also a steel works at Reinosa.

Further particulars of the works of this company will be found in the report, on page 379, of the speech of welcome made by the Conde de Zubiria.

Six spans of the Orielton Viaduct, near Barmouth, Great Western Railway, are to be filled in by embankment, and the remaining three spans are to be renewed. Three timber viaducts near Langport, on the Yeovil branch, are to be reconstructed in steel.

Letters to the Editor.

We do not hold ourselves responsible for the opinions of our correspondents.)

STATIC BALANCING OF ROTORS.

Sir,—In your issue of September 14th, Dr. Hans Heymann attacks the purport of my article on "Static Balancing of Rotors," and asserts that it is common knowledge in practical circles that static balancing, however carefully carried out, is totally insufficient. The purport of my article—which appeared in your issues of March 23rd and 30th, 1928—was "to indicate why different methods of balancing are preferred in different circumstances, and to contrast the advantages of static and dynamic balancing." It was not suggested that static balancing is always sufficient, although it was shown that great advantages are often secured by static balancing, and that the additional advantage gained by dynamic balancing is often very slight. And it was shown that even dynamic balancing at moderate speed is not necessarily sufficient to insure satisfactory operation at higher speeds. The article approached the subject by studying and contrasting the different kinds of vibration produced by unbalanced forces and by unbalanced couples.

Dr. Heymann objects to the division of the subject into the two familiar parts known as static and dynamic balancing, and says, "It is difficult to understand why the forces of dynamic unbalance should have less influence on bearings, frame and bed-plate than the forces arising from static unbalance of equal magnitude." One fundamental reason is clearly illustrated in Fig. 1 in my article, and is well known: The action of a couple of equal and opposite forces depends on the arm of the couple—*i.e.*, on the distance between the lines of action of the forces; and when the arm is short in comparison with the distance between the bearings, a couple of large forces produces only small loads on the bearings and small bending moments in the shaft.

For rotors of certain shapes, in which the arm of the couple may be longer in proportion to the distance between the bearings, dynamic balancing may be desirable and even necessary. For such cases I ventured to recommend a method that has long been in general use, viz., the elimination of the couple by dynamic balancing after the resultant force has been accurately eliminated by static balancing. Dr. Heymann disapproves of this method, and the ground of his opposition is as follows:—"Assuming that perfect static balance has been attained by the Martin gravity scale, it would be essential that the compensation weights for the dynamic post balancing should form a clean couple. . . . If this condition were neglected, a fresh state of static unbalance would be created." In other words, Dr. Heymann fears that the operator of the dynamic balancing machine, undertaking even the simplest possible task of eliminating a pure couple, may add the compensation weights so clumsily that he destroys the good work already accomplished by static balancing. It is to be hoped that such fears are groundless.

As my article dealt with static balancing, only one simple dynamic balancing machine was illustrated—and that only for a specific object, viz., to show how static and dynamic unbalance are readily distinguished experimentally, by studying the different kinds of vibration produced at two distinct critical speeds. Dr. Heymann ridicules this machine as "hopelessly obsolete"; but in my view, it still remains a serviceable type—simple and readily understood, and particularly well suited for the work that it was originally designed to do, viz., to eliminate couples from rotors that are already statically balanced. If this simple machine has not always been justly appreciated it may be largely because its task has often been made too complex in respect that the rotors have not been statically balanced beforehand with sufficient accuracy. My illustration—Fig. 7—in the article, showed clearly how the confusing effect of any residual static unbalance might be minimised by running this type of machine at the higher of its two critical speeds.

My article showed also why rotors that have been accurately balanced dynamically at moderate speeds—such as can be used with safety in the open air in dynamic balancing machines—may run out of balance at higher speeds in service and return to balance when the speed is lowered. The shafts of such rotors flex elastically under the bending moments that still remain after dynamic balancing. Dr Heymann quotes a case in which an attempt to attain what I have called "internal" balance was unsuccessful, and others might be added—for the process is difficult and demands care in several directions; but this experience does not vitiate my contention that dynamic balance is not fully equivalent to internal balance, or that in the case of rotors with long elastic shafts, it is desirable to make whatever effort may be practicable to attain internal balance.

An important part of my article showed how widely different in general are the whirling actions, and also the external vibrations, produced by unbalanced forces and by unbalanced couples. And I believe I showed—clearly and with only such mathematical expressions as were essential—that the relative importance of static and dynamic unbalance, in provoking whirl in particular, depends on the relation between the running speed and the critical whirling speed or speeds. Dr. Heymann's attack on this analysis passes through four distinct stages as follow:—(1) It is asserted that the critical speed and the effect of unbalance "really have no relation with each other"; (2) by singling out from my analysis a well known equation that expresses the relation between static unbalance and vibration at different speeds, it is implied that my analysis disregards dynamic unbalance; and it is asserted that my deduction therefore, "to say the least, is untenable"; (3) it is recognised that other equations were in fact employed to express the effect of dynamic unbalance, and it is admitted that "theoretically this conclusion is correct"; and (4) it is asserted that the validity of the conclusion is vitiated "in practice" by subsidiary actions vaguely described as "thrusts or concussions transmitted from the bearings or the frame."

There can be no real doubt that the method and conclusions given in my article are in fact valid within the limitations of the case studied—a symmetrical rigid rotor on a massless elastic shaft. This simple system was adopted for an obvious reason, to facilitate analysis and explanation; and it is attractive in this respect chiefly because the effect of an unbalanced couple does not depend upon and can be described without stating the lines of action of the unbalanced forces. In other circumstances, *e.g.*, if the rotor is elastically flexible as a whole, the effects vary with the location of the unbalanced masses along the shaft in much the same way as I described for the comparable vibrations in ships. It is in such circumstances that internal balance becomes important, as neither static nor dynamic external balance suffices to obviate vibration. The conclusions that I gave remain valid for single unbalanced forces or couples with short arms, acting at or about the section that is the antinode for the primary whirl and the node for the secondary; and in practice, for rotors of ordianry shape, they afford a reliable indication of the influence of speed on the relative importance of the two components of external balance. B. P. Haigh.

Greenwich, September 26th.

WASTE HEAT RECOVERY.

Sir,—We are glad to see the letter signed "M.I. Mech. E." in your issue of the 21st inst., as it affords us an opportunity to clear up one or two points which may not have been quite obvious to your readers.

Your correspondent admits the possibility of using advantageously the "free steam" from waste heat boilers, and only criticises the way in which some steelworks managers use the steam in reversing rolling mill engines. This you will have to admit has nothing to do with the recovery of waste heat. The "free steam" can be used quite well in a turbine, if this suits the works. "M.I. Mech. E." must allow that wherever fuel is being burnt to raise steam in a steelworks there is room for the installation of waste-heat boilers.

Large quantities of heat are at present passing up the chimney stacks from the steel and reheating furnaces, and about half of this can be saved at once as steam, with so small a capital outlay that the cost is returned within a couple of years or so. The adoption of electrically-driven mills would be ideal from the technical point of view, but unfortunately the provision of new capital is a serious stumbling block in the present state of the fundamental industries of this country. Certain foreign firms have been able to reduce their capital commitments by making a commercial success of repudiation, and being blessed with more economical government and more enlightened Trade Union leadership, they are in a better position to instal and make use of the most modern plants.

"M.I. Mech. E." refers to low production costs on the Continent, and in the daily Press this week Sir Robert Horne is quoted as saying, when referring to the utilisation of waste heat from industrial furnaces, that "in Germany as well as in France great advances have been made in this direction, and we may learn much from their experience." A recent report on "Fuel Economy in the German Iron and Steel Industry" mentions (see *Iron and Coal Trades Review* for November 11th, 1927, page 713), "the growing influence of the use of steam raised in waste-heat boilers," this having risen from 5 per cent. in 1920 to 45 per cent. in 1926. All this controverts "M.I. Mech. E.'s" assumption that waste heat recovery is not appreciated on the Continent.

We have looked again at the paragraph in our last letter objected to by your correspondent, and consider that our remarks are quite justified by incidents within the experience of most of the readers of your paper. Amongst these might be cited the strong arguments advanced against the adoption of high-tension steel for boilers; overhead lines for electric power transmission; electric power for cranes, &c.; cut gearing; motor cars for road transport, and even the steam turbine now advocated by "M.I. Mech. E."

If things were otherwise, and new departures were welcomed in their earlier stages, as they are appreciated later, there would be no real pioneering, we should all be on the same high level, "none greater or less than another." As things are, pioneers are called "interested specialists" by those who are not travelling in the van of progress.

Joseph Adamson and Co.

Hyde, September 26th.

[We leave it to our correspondent, "M.I. Mech. E." to deal with the points in Messrs. Adamson's letter, which refer especially to him, but we must protest against the attitude which they continue to maintain in regard to our article. Surely it is the business of all self-respecting engineers to examine technical problems from all points of view and not purposely to overlook selected arguments because they may be injurious to trade. Intelligent critical opposition ought not to be condemned; in the long run, it consolidates the position of what is really good. In citing stages in progress which have withstood opposition, Messrs. Adamson forget those, whose name is legion, which have failed to stand the test, but which, if there had been no intelligent criticism, might have been foisted upon the world for the benefit of trade. They have quoted one text; let us quote another, "Prove all things."—Ed., The E.]

American Engineering News.

Steam-electric Pumping Plant.

In the new pumping and filter plant of the waterworks at Knoxville, there is an unusual combination of steam and motor-driven equipment. The high-lift plant consists of two multi-stage turbines, each geared to a shaft which drives two centrifugal pumps, delivering 15,000,000 gallons daily against 350ft. head. On an extension of this shaft is mounted a 300-kW direct-current generator furnishing power for the low-lift pumps and miscellaneous station motors. The low-lift plant consists of two centrifugal pumps delivering 18,000,000 gallons daily against 55ft. head, each being driven directly by a 220 H.P. motor. Direct current is used in this case, on account of the variable pumping head, and to insure high efficiency under a variety of pumping conditions. A small turbo-generator set operates the lighting plant when the high-lift plant is shut down. A separate motor-driven pump supplies an elevated tank serving wash water to the filters. The low-lift pumping units have developed 79·4 per cent. overall efficiency, with a pump efficiency of 85 per cent. The main or high-lift units are designed for a duty of 191,000,000 foot-pounds per 1000 lb. of superheated steam, this work including the output of the generator. There are two water-tube boilers of 500 H.P. capacity, working at 300 lb. pressure with 20 deg. superheat. Water is pumped from the Tennessee River to settling basins, from which it goes to the sand filters.

Tunnel Ventilation.

When the 6-mile Moffat Tunnel in the Rocky Mountains was leased by the Denver and Salt Lake Railway, the railway decided to operate with steam locomotives, as the traffic was relatively light and the cost of electrification was considered prohibitive under the circumstances. The ventilation of a tunnel 6 miles long, with no intermediate shaft, was a serious problem, necessitating considerable study. Under the system adopted, the east portal is closed by a steel and canvas portcullis door when a train is in the tunnel, and a ventilating plant at that end creates a current of air opposing the train, the fans working as forced draught in the case of eastbound trains and induced draught for westbound trains. Automatic apparatus raises the door in eight seconds, as an eastbound train approaches. For forced draught the fans draw in air through louvres in low towers and deliver it to the tunnel, whence it escapes at the west end. For induced draught, the air enters at the west end, and the fans discharge it through the tower openings, the appropriate air conduits being opened or closed by electrically operated machinery and swinging valves or doors. Two fans are used, but one is sufficient for regular operation. They handle 350,000 and 450,000 cubic feet per minute respectively. As the gradients slope up to the middle of the tunnel, the engines work with very little steam beyond the summit, and the tunnel is usually cleared of all smoke and gas in about 30 minutes.

Electric Pumping Station.

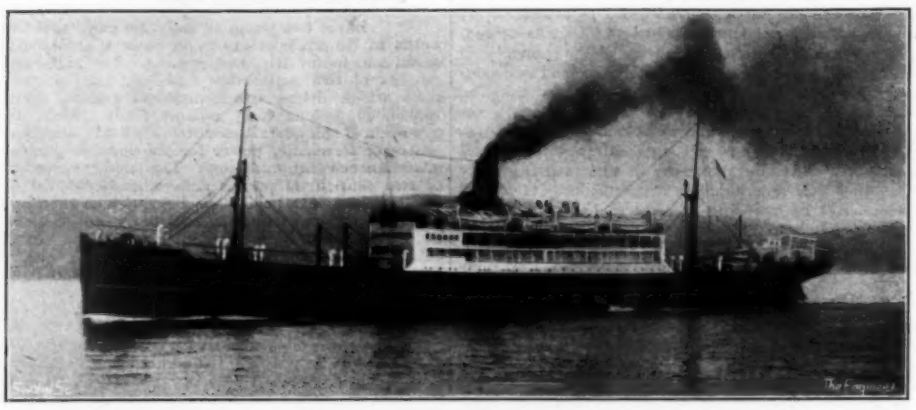
In the electrification of a waterworks pumping station at Philadelphia, seven steam-driven centrifugal pumps with a total daily capacity of 280,000,000 gallons, have been replaced by six electrically driven centrifugal pumps, giving a capacity of 300,000,000 gallons. Each pump is driven by a 600 H.P., 2300-volt motor. As the specifications called for an average overall efficiency, from the bus-bars to the delivered water, of 76 per cent. at full and three-quarter rating, the pumps were built for 83 per cent. efficiency and the motors for 92 per cent. efficiency. On test the overall efficiencies of the several units ranged from 77·3 to 83·3 per cent. Also the units have delivered an average of 56,000,000 gallons each, or a total average of 324,000,000 gallons daily, an increase of 20 per cent. over the capacity of the steam plant. At one time when the station was shut down for repairs to a pipe line, it delivered at the rate of 300,000,000 gallons daily in six minutes after all the pumps were running. Power is supplied through two 3750-kVA, 60-cycle, 13,200 to 2200-volt transformer banks. The starting pressure is 1500 volts. For starting, each motor has a manually-operated oil circuit breaker, and two 2300-volt magnet contactors, one for starting at 1500 volts and one for running at 2300 volts. With steam operation the plant required a total force of seventy men. With electric operation there are only seven men; a chief engineer, with two men on each eight-hour shift.

Automatic Combustion Control.

Regulation of combustion conditions in accordance with variation of steam pressure is in successful operation on two batteries of boilers in the central station of the electric light and power company at Indianapolis. One battery has three boilers totalling 10,570 square feet of water heating surface, and the other has four boilers totalling 7950 square feet. A master regulator operates on steam-pressure variations, and these variations are transmitted by compressed air at low pressure to regulators on the boilers. Each boiler has its own forced draught equipment and mechanical stoker driving apparatus. Steam is carried at 235 lb. gauge pressure and 175 deg. Fah. of superheat. Pressure in the compressed air cylinders of the controllers is 85 lb. to 100 lb. during the day and 65 lb. to 120 lb. at night. The master regulator is actuated by the variations of steam pressure in the ring header from which the turbine connections lead out. The fans and stokers are driven by constant-speed motors, so that these cannot be regulated, but the flow of air to the furnaces is varied by means of louvres in the wind-box, operated by the combustion controllers. To secure uniform combustion, the master regulator varies the chimney dampers from wide open at 232 lb. pressure to practically closed at 248 lb. The combustion controllers maintain the draught above the fires at 0·09in. to 0·11in. of water. This uniform flow of air cools the stoker parts more effectively and maintains a more uniform furnace temperature than was possible with hand regulation.

THE ANCHOR LINER BRITANNIA

ALEXANDER STEPHEN AND CO., LTD., LINTHOUSE, BUILDERS



Bauer-Wach Turbine Equipment on the Anchor Liner Britannia.

The Anchor liner "Britannia," shown in the accompanying illustration recently completed her trials over the measured mile at Skelmorlie, after being fitted with a Bauer-Wach exhaust turbine arrangement at the Dalmuir yard of William Beardmore and Co., Ltd. The trials were carried out on Thursday and Friday, September 20th and 21st, those of the first day being confined to running the ship with her original reciprocating engine, and those on the second day with both the reciprocating engines and the new exhaust turbine. It was shown that the added exhaust turbine has brought about a saving in fuel consumption of over 20 per cent., with a great improvement in overall efficiency. This result is the more interesting because when she was commissioned only two years ago, the "Britannia" was looked upon as a very economical vessel of her type. She was launched in 1925 by Alexander Stephen and Co., Ltd., at Linthouse, and has a gross tonnage of 8463, the designed speed of the ship being about 13¼ knots, on a draught of 27ft. 5in. The propelling machinery was also supplied by the builders of the ship, and it consists of a single set of quadruple expansion steam engines with cylinders having bores of 29½in., 42½in., 60½in., and 87in., and a stroke of 54in. Steam is supplied by oil-fired boilers fitted with superheaters.

In Fig. 1 we give a general arrangement drawing of the engine as now equipped with the exhaust turbine unit; while in Fig. 2 a section through the turbine and gearing and the Beardmore-Vulcan hydraulic coupling is reproduced. The whole of the installation work was carried out in eight weeks, which, considering the alterations which had to be made to the tank top seatings and the new condenser connections, is a very creditable piece of work.

A very neat arrangement of plant has been made and the total weight of the main engine, namely, 320 tons, has only been increased by some 60 tons; while there has been no need to alter the 49ft. length of the engne-room. Some small modifications were made to the auxiliary coupling, and a vacuum augmentor was fitted.

The arrangement of the steam and exhaust connections is shown in Fig. 1. In order to prevent the possibility of lubricating oil reaching the turbine or the condenser, a vortex steam dryer is fitted in the exhaust pipe. The steam passes from the exhaust main to an oil-controlled two-way valve, the purpose of which is to lead it direct to the turbine, when in use, or direct to the condenser, when the turbine is not required. The oil pressure system operating the two-way valve is connected with that for filling the hydraulic coupling, so that the two halves of the Beardmore-Vulcan clutch are always filled with oil and the turbine connected to the propeller shaft before the steam is diverted from the main condenser and passed through the exhaust turbine to the condenser. The two-way valve on the "Britannia" is of the double-beat type, and the actual time which is required to run up the turbine and to bring it into full operation is about 2½ minutes. It can, however, be instantly disconnected by simply draining the oil from the two halves of the coulping, after which the engine is ready for reversing or manœuvring.

A complete section through the turbine gearing and coupling is reproduced in Fig. 2. A Parsons reactor turbine, designed to run at a speed of 2800 r.p.m., with an output of about 30 per cent. of the total engine power, is employed. There are about 6 tons of moving blades, and at the forward end of the turbine shaft are the governor, and the Michell thrust bearing. At the other end of the shaft is the pinion of the first reduction gearing. A single helical gearing is adopted, the gear and steam thrust being easily balanced and taken up. It will be seen that the gear meshing with the first reduction pinion is mounted on the outer casing of the driving member of the Beardmore-Vulcan clutch. The driver member is coupled, in turn, to the pinion of the second reduction gearing. This is again a single helical gear and the thrust is taken up by the action of the oil within the clutch. This pinion meshes with the main gear wheel, which is mounted on a hollow sleeve and connected by a short distance piece to the main propeller shaft. A thrust bearing is also provided on this shaft. The adoption of a quill-drive permits the

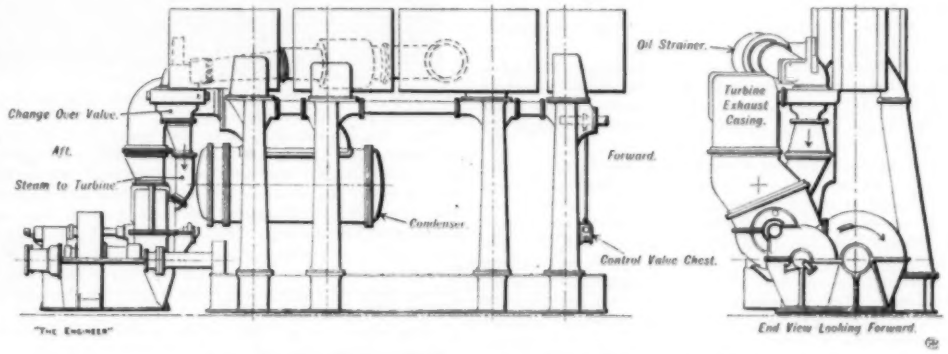


FIG. 1—ARRANGEMENT OF ENGINE AND EXHAUST TURBINE

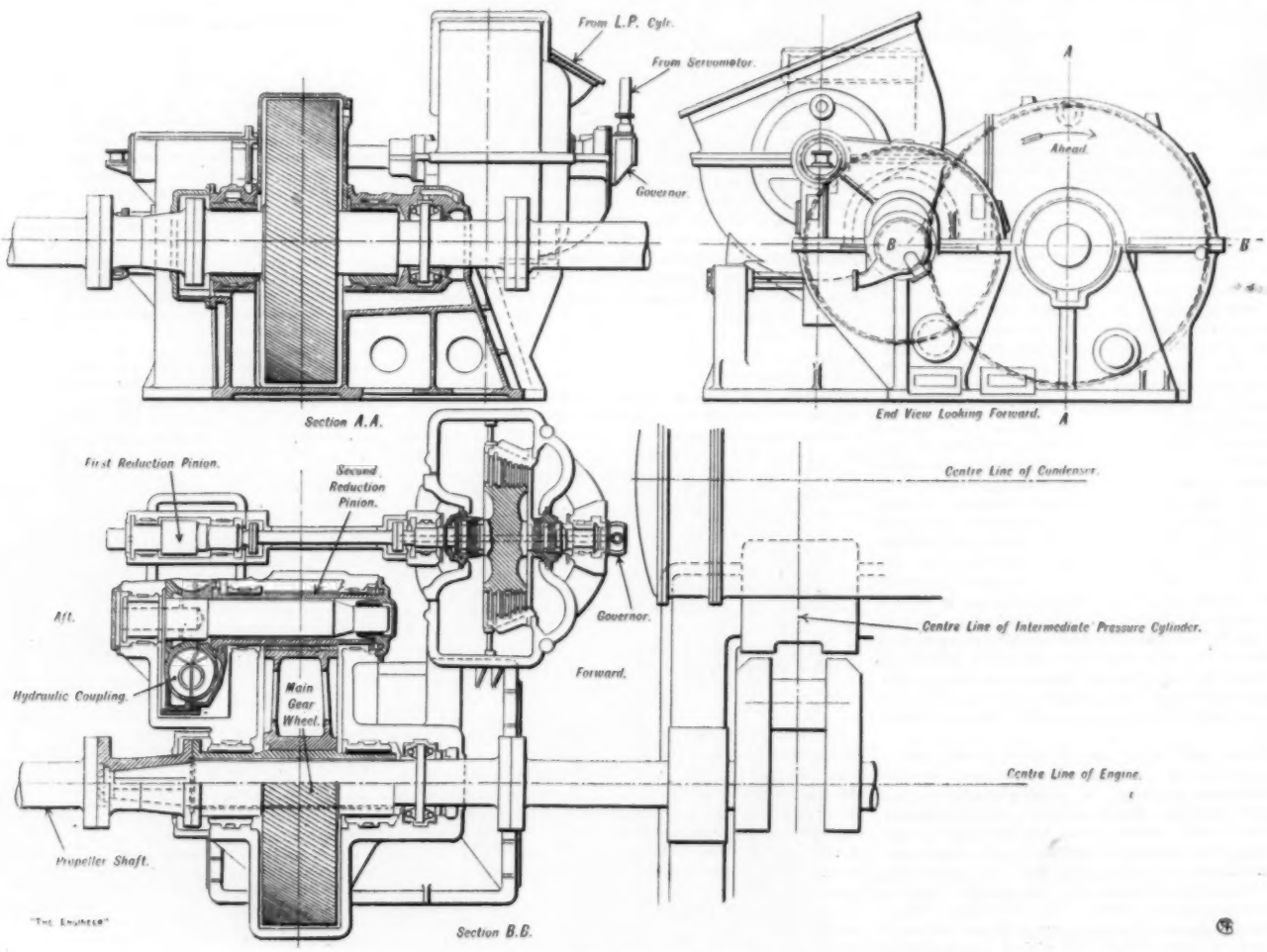


FIG. 2—ARRANGEMENT OF TURBINE, GEARING AND HYDRAULIC COUPLING

BAUER-WACH TURBINE EQUIPMENT ON THE ANCHOR LINER BRITANNIA

TABLE I.—*Trial with Reciprocating Engine Alone.*

Time.	8.49 p.m.	9.49 p.m.	10.49 p.m.	11.49 p.m.	12.49 a.m.	Mean, 8.49 p.m.–12.49 a.m.
Boilers—						
Pressure	205	203	202	215	210	207
Temperature	415	420	420	412	405	414·4
Superheat	25	31	32	18	13	24
Main steam boiler side of engine stop valve—						
Pressure	210	207	207	210	210	208·8
Temperature	435	435	435	430	430	433
Superheat	43	44	44	38	38	41½
Receiver pressures—						
1st I.P.	115	114	114	117	117	115·4
2nd I.P.	44	42	43	43·5	43·5	43
L.P.	8	8	8½	7½	7·3	7·8
L.P. cylinder exhaust pressure—						
Before separator	21·5	21·5	22	22	22	21·75
After separator	—	—	—	—	—	—
Turbine inlet—						
Pressure	—	—	—	—	—	—
Temperature	—	—	—	—	—	—
Turbine exhaust—						
Pressure	—	—	—	—	—	—
Temperature	—	—	—	—	—	—
Vacuum gauge	26·59	26·92	26·85	26·85	26·90	26·83
Kenotometer	3·6	3·3	3·4	3·4	3·35	3·4
Barometer	30·19	30·22	30·25	30·25	30·25	30·23
Temperature suction from condenser, deg. Fah.	92	94	94	94	96	94
Mean pressures—						
H.P.	70	69·5	71	68·75	71·87	70·2
1st I.P.	42·6	43·75	43	44·85	44·1	43·66
2nd I.P.	18·0	18·0	18	18·6	18·9	18·3
L.P.	8·925	9·0	8·875	8·45	8·45	8·94
I.H.P., reciprocating engine—						
H.P.	1129	1105	1130	1095	1152	1123
1st I.P.	1422	1450	1425	1480	1465	1448
2nd I.P.	1230	1215	1215	1255	1288	1240
L.P.	1250	1245	1230	1170	1178	1215
Total	5031	5015	5000	5000	5083	5026
Equivalent I.H.P. turbine	—	—	—	—	—	—
Total I.H.P.	5031	5015	5000	5000	5083	5026
Revolutions per minute—						
Engine	84·53	85·98	85·47	85·14	86·2	85·46
Turbine	—	—	—	—	—	—
Cut-offs—						
H.P.	·68	·68	·68	·68	·68	·68
1st I.P.	·6	·6	·6	·6	·6	·6
2nd I.P.	·6	·6	·6	·6	·6	·6
L.P.	·6	·6	·6	·6	·6	·6
Refrd. mean pressure	36·1	36·2	36·15	36·15	36·5	36·2
Number of boilers in use	4	4	4	4	4	4
Oil fuel burners—						
Size	20	20	20	20	20	20
Number in use	15	16	16	16	16	16
Oil fuel pumps, D.S.	18	18	17½	15½	15½	16·9
Oil fuel pressure	112	120	115	110	105	112
Oil fuel temperature	230	230	226	220	220	224
Air pressure—						
Fan, inches	2¼	2¼	2¼	2¼	2¼	2·2
Furnaces, inches	¼	¼	¼	¼	¼	·7
R.p.m., fan	295	297	290	290	290	292
Feed temperature—						
Hotwell, deg. Fah.	94	96	96	96	98	96
Feed pump, deg. Fah.	172	110	108	196	198	197
D.S. feed pump	793	802	817	801	785	800
R.p.m., circulating pump	342	291	282	270	300	297
Sea temperature, deg. Fah.	56	56	56	56	56	56
Circulating discharge temperature	—	—	—	—	—	—
Air temperature entering furnaces, deg. Fah.	260	294	280	264	262	272
Temperature of gases—						
At uptakes	630	630	625	625	620	626
At base of funnel	500	500	490	490	480	492
Lubricating oil pressure—						
Regulating valve	30·5	38	35·5	40	39	36·6
Filling to clutch	0	0	0	0	0	0
Turbine bearings	9	13	12·5	13	13	12
Gear case bearings	11	16	16·5	16·5	16·5	15
Oil fuel—						
Lb. per hour	—	—	—	—	—	5240
Lb. per I.H.P. per hour	—	—	—	—	—	1·04
Temperature of boiler-room	98	97	96	97	—	97

TABLE II.—*Trial with Reciprocating Engine and Exhaust Turbine.*

Time.	12.05 p.m.	1.05 p.m.	2.05 p.m.	3.05 p.m.	Mean of three hours.
Boilers—					
Pressure	215	210	210	210	211
Temperature	400	400	400	395	398
Superheat	6	8	8	3	6
Main steam boiler side of engine stop valve—					
Pressure	213	210	210	210	211
Temperature	420	430	430	430	428
Superheat	27	38	38	38	35
Receiver pressures—					
1st I.P.	85	85	85	87	85
2nd I.P.	33	33	33	34	33
L.P.	7	6·8	8·2	8·5	7·6
L.P. cylinder exhaust pressure—					
Before separator	13	15	14	14	14·5
After separator	—	—	—	—	—
Turbine inlet—					
Pressure	11·5	12·8	12	16	13·1
Temperature	—	—	—	—	—
Turbine exhaust—					
Pressure	—	—	—	—	—
Temperature	—	—	—	—	—
Vacuum gauge	27·98	28·08	28·03	28·08	28·04
Kenotometer	2·3	2·2	2·25	2·2	2·24
Barometer	30·28	30·28	30·28	30·28	30·28
Temperature suction from condenser, deg. Fah.	90	96	94	94	93·50
Mean pressures—					
H.P.	69	70	70·65	71·25	70·2
1st I.P.	31·2	32·4	32·4	31·75	31·9
2nd I.P.	11·88	12·3	11·7	11·15	11·76
L.P.	5·25	5·25	5·38	5·9	5·44
I.H.P., reciprocating engine—					
H.P.	1090	1122	1115	1125	1113
1st I.P.	1022	1080	1065	1044	1053
2nd I.P.	795	835	786	745	790
L.P.	718	730	743	813	751
Total	3625	3767	3709	3727	3707
Equivalent, I.H.P. turbine	1450	1308	1266	1233	1315
Total I.H.P.	5075	5075	4975	4960	5022
Revolutions per minute—					
Engine	85·7	84·6	84·96	85·06	85·08
Turbine	—	—	—	—	—
Cut-offs—					
H.P.	·5	·52	·52	·52	·52
1st I.P.	·595	·595	·595	·595	·595
2nd I.P.	·56	·56	·56	·56	·56
L.P.	·56	·56	·56	·56	·56
Refrd. mean pressure	26·5	27·05	26·9	27·15	26·9
Number of boilers in use	4	4	4	4	4
Oil fuel burners—	2 blrs. 14	2 blrs. 12	12	12	
Size	2 blrs. 16	2 blrs. 14	14	14	12 & 14
Number in use	16	16	16	16	16
Oil fuel pumps, D.S.	12½	11	12	12	12
Oil fuel pressure	95	95	100	105	99
Oil fuel temperature	190	215	210	210	206
Air pressure—					
Fan, inches	1⅞	1¼	1¼	1¼	1·56
Furnaces, inches	¼	¼	⅜	¼	·3
R.p.m., fan	250	250	250	255	251
Feed temperature—					
Hotwell, deg. Fah.	94	98	96	96	96
Feed pump, deg. Fah.	200	202	202	202	201·5
D.S. feed pump	715	675	677	675	685·0
R.p.m., circulating pump	300	205	270	250	267
Sea temperature, deg. Fah.	55	56	56	56	56
Circulating discharge temperature	—	—	—	—	—
Air temperature entering furnaces, deg. Fah.	248	252	256	254	252·5
Temperature of gases—					
At uptakes	590	590	590	585	590·0
At base of funnel	450	450	455	456	452·0
Lubricating oil pressure—					
Regulating valve	40	40	39·5	42	40·0
Filling to clutch	11	11	11	10	11·0
Turbine bearings	12	12·5	12	12·5	12·25
Gear case bearings	16	16	15·5	16	15·8
Oil fuel—					
Lb. per hour	5040	3920	4480	3920	4178
Lb. per I.H.P. per hour	—	—	—	—	·832
Ejector steam pressure	130	126	127	125	127
Temperature of boiler-room	92	94	97	96	95

main gear wheel sleeve to revolve in its own very substantial bearings, and the drive is, moreover, unaffected by any wear in the crank shaft bearings of the main engine. The arrangement further enables the turbine drive to be easily disconnected from the propeller shafting, should this prove to be necessary at any time.

The tables which accompany this article show the careful and extensive readings which were taken during the two trials. They were run under almost identical conditions as regards weather, sea and ship condition. The ship had a draught forward of 12ft. 9in., with a 20ft. 8in. draft aft or a mean draught of 16ft. 8½in. With the machinery developing about 5000 I.H.P., the fuel consumption per day was 56·1 tons of oil with reciprocating machinery only and 44·8 tons with the reciprocating engine working in conjunction with the exhaust steam turbine. The installation was shown to be a most satisfactory one from all points of view, and we are interested to learn that the builders have several other orders on hand.

South African Engineering Notes.

New Cement Companies.

Two new cement companies have just been formed, one in Northern Rhodesia and one in the Union of South Africa. The first is the Northern Rhodesia Lime and Cement Company, Ltd., formed with the object of establishing the Portland cement industry in Northern Rhodesia, and to acquire the Chipongwe Estate on which the lime deposits are situated. The estate abuts on the main line of the Rhodesia Railways. The siding is 235 miles from the Congo border and 350 from Wankie Collieries. It is anticipated that the sales from the factory will rapidly reach a minimum figure of 120,000 bags per annum. The cement consumed in Northern Rhodesia amounted to 34,000 bags in 1925, and to 52,000 bags in 1926. The figures for 1927 are not yet available, but are known to show a considerable increase over 1926. In addition, large quantities of cement were railed from the Union and Southern Rhodesia to the Congo.

The other concern is the Eastern Province Cement Company, an offshoot of the famous Pretoria Portland Cement Company. Its factory is being erected 4½ miles from the port Elizabeth Town Hall, and is on the main line to the north. Excellent progress is being made with the erection of the plant, and it is anticipated that it will be in full swing by the end of the year, producing 4000 tons of cement per month. Full advantage has been taken of the natural fall of the ground in laying out the plant, which has eliminated, to a great extent, the installation of conveyors and elevators. The whole of the plant will be electrically driven, power being obtained from the Port Elizabeth mains at 22,000 volts. The company has already made tentative arrangements for doubling the capacity of the plant, which it is anticipated will be necessary in the near future.

More British Trucks.

The Railway Administration has decided to increase the order recently placed with Vickers Metropolitan Carriage (S.A), Ltd., which tendered on behalf of the Metropolitan Carriage, Wagon and Finance Company, Ltd., of Birmingham, for 500 four-wheeled steel drop-sided wagons, to a total of 1000, at the price quoted in the original tender, namely, £200 per wagon delivered f.o.b. Liverpool, the second 500 to be delivered within six weeks of completion of the first 500 wagons.

Roads and Bridges.

During the current financial year the Transvaal Provincial Council intends to expend £470,000 upon roads and bridges. Bridges costing £57,000 are in hand, also small bridges and causeways to a total of £10,000. During the current financial year the Southern Rhodesian Assembly has sanctioned the spending of £185,000 upon roads and bridges. The construction of a gravel road between Bulawayo and the Victoria Falls is also being considered, but at present funds do not permit as the cost would be £60,000. The railway bridge over the Unifolozi River in Zululand has twice been completely washed away, and to obviate similar occurrences in future the Administrations engineers have prepared plans for a new bridge at a fresh site, which necessitates a deviation and tunnel for the line. The new bridge will be one of the longest in South Africa, consisting of eleven 150ft. spans, and will be considerably higher from normal water level than the old. It will provide accommodation for road traffic as well, by means of cantilever brackets from the main structure. The cost is estimated at £260,000, and tenders are now being invited for the structure.

Potgietersrust Platinum Production.

It is clear from the report of the Technical Committee of the Potgietersrust Platinums, Ltd., for the quarter ended June 30th, 1928, that the property of the company will in a very short space of time be producing on a large scale, and at a good profit. The daily assay of screen and residue indicated a value of 6·58 dwts. and 2·22 dwts. of platinum group metals per ton respectively, and the actual recovery, calculated from the estimated value of the concentrates won is 4·49 dwts. of platinum group metals per ton of ore treated. The difference in the two results is not much, as the assays would give 4·36 dwts. But in either case the loss in residue is very high, over a third of the total content. The richness of the ore, however, is indisputable. The good news bearing on the future is that the plant which is being erected by the Chemical and Metallurgical Corporation at Runcorn, England, for the treatment of concentrates, is nearing completion. Bulk tests have been carried out and showed a good extraction at a reasonable cost. Important work is being carried on locally on a chlorination process for the treatment of concentrates. The method shows a good deal of promise, and will be a big advance on current practice if it is as successful as indicated.

A New Electric Welding Dynamo.

At the works of Alloy Welding Processes, Ltd., of 14–16, Church-street, Islington, we recently inspected a new constant-current electric welding dynamo, which is remarkably simple and efficient in operation. It has been designed to reduce the time lag of the field windings to a minimum, and it does not necessitate the use of a reactor in the arc circuit. As it is completely self-exciting, it naturally does not need a separate exciter. If the machine is provided with a shunt regulator for setting the value of the current, welding can be carried out with all the

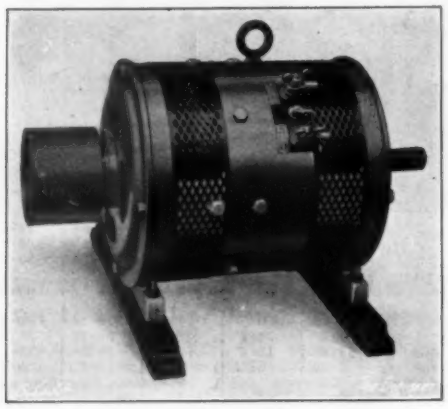


FIG. 1—WELDING DYNAMO

standard sizes of electrodes without the use of other accessories.

In arc welding there are usually two causes of disturbances. The first is the presence of small high-frequency oscillations caused by the arc, but they are readily damped out by the normal self-induction of any dynamo that supplies the arc directly. The other disturbance is usually attributable to the fact that owing to the time lag in the dynamo field windings, the current does not follow the arc voltage changes with sufficient rapidity. In order to obtain automatic regulation of the voltage many welding dynamos are provided with differential field windings, but owing to the mutual induction between the two sets of

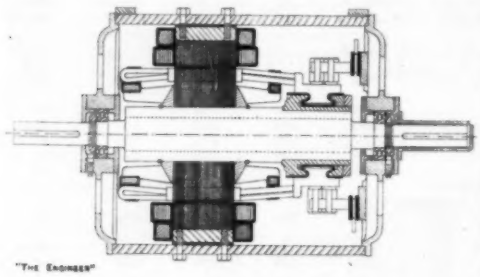


FIG. 2—SECTION THROUGH WELDING DYNAMO

coils an appreciable time elapses before the current settles down to a new stable value caused, say, by a change in the length of the arc. If an arc is supplied direct from such a machine, without the intervention of a reactor or choking coil, serious spluttering of the metal takes place at the arc.

This new type of generator has been designed to supply a practically constant current to the arc, and the time lag in the field is so small that a reactor is unnecessary. When a stabilising reactor is employed, it is an easy matter for an unskilled operator to maintain an arc, but really good welding can only be obtained by a skilled operator on comparatively heavy work. In order to secure efficient welding under all circumstances, the arc must be kept as

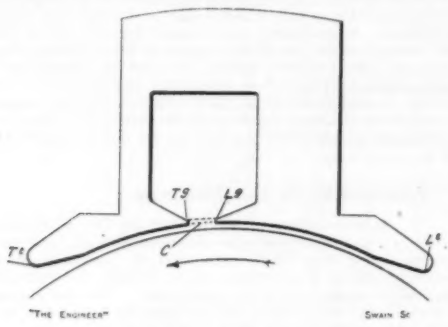


FIG. 3—POLE PIECE

short as possible. But when a reactor is in use there is considerable danger in keeping a short arc, owing to the fact that when the molten metal is touched with the electrode changes occur in the energy stored in the reactor, and these either cause serious spluttering, or if the metal is thin ruptures the article being welded. In the machine under consideration, however, the magnetic energy stored in the arc circuit is comparatively small, and the speed at which the voltage can change to suit the current is very great. The result is that it is possible to weld with the electrode actually trailing in the molten metal. Recognising that opposition windings for obtaining the self-regulating property would be of doubtful value, the designers of this new machine turned their attention to the possibility of producing a constant-current dynamo, with a cumulative series winding on the poles, and capable of giving a current range of from 50 to 200 ampères by altering the magnetomotive force of the self-exciting winding only. The machine—shown in Figs. 1 and 2—closely resembles a standard multipolar compound-wound dynamo but in order to secure the proper characteristics for welding the pole faces are divided into two parts, as shown in Fig. 3. Instead of the air gap being uniform over the whole polar arc, the horizontal central part of the pole shoe face is cut away, so that little or no flux enters the armature through this part. This cut-away portion may be symmetrical with the polar axis, or it may be greater on one side of the polar axis than on the other, depending on the effect desired. Moreover, the open gap may be closed by a thin bridge piece, as shown by the dotted lines C in Fig. 3, in order to reduce noise.

The operating characteristics of the machine are governed by the relative reluctance of the two main parts of each pole. Referring to Fig. 4, which shows the pole

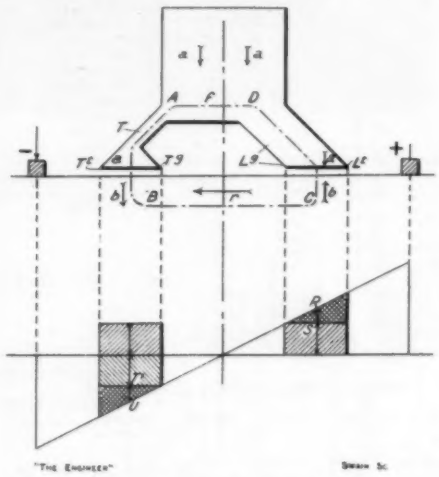


FIG. 4—MAGNETO-MOTIVE-FORCE DIAGRAM

construction in an exaggerated form, let it be assumed that the magnetic reluctance along the path A B is nine times that along the path C D; then obviously it will take nine times the magnetomotive force to drive one unit of flux along the path A B as it does to drive a unit of flux along the path C D, the reluctance of the paths A D and B C being assumed to be negligible in the meantime. If it be assumed that the magnetomotive force "*a*"—Fig. 4—be four units, then when the armature current has risen to a value at which the armature magnetomotive force is 10 units, there will be 5 units "*b*" of armature magnetomotive force acting against the main magnetomotive force in the path C D and 5 units "*b*" acting with the main magnetomotive force in the path A B. That is, there will be 9 units of magnetomotive force acting on the path A B against a reluctance of 9 units to send a flux of 1 unit into the armature on the pole face T *t*–T *g*, and there will be four minus five, or one minus unit of magnetomotive force acting on the path C D to send 1 unit of flux back into the pole against the reluctance of the high reluctance part T as will leave a residual part T′ U to force the flux "*f*" across the gap T *t* T *g*, while the residual magnetomotive force R S should be just sufficient to force the flux "*f*" across the air gap L *g*–L *t*, thus leaving no magnetomotive force available for driving flux across the whole armature from pole to pole, except the small amount that may be necessary to generate voltage in the armature to balance the internal loss when the short circuit current is flowing.

It will be seen, therefore, that, on the assumption that there is no armature reaction to modify the proportions of flux entering the armature at each side of the pole, the flux from, say, the north pole divides into two parts, one entering the armature from the face L *t*–L *g*, and the other part entering from the pole face T *t*–T *g*, and the proportions of flux entering the armature from each side will depend on the relative reluctances of the two pole parts.

When the machine is working as a dynamo there will, of course, be a cross magnetising effect due to the cross armature ampère turns, and this will oppose the polar flux over that part of the air gap under the leading horn

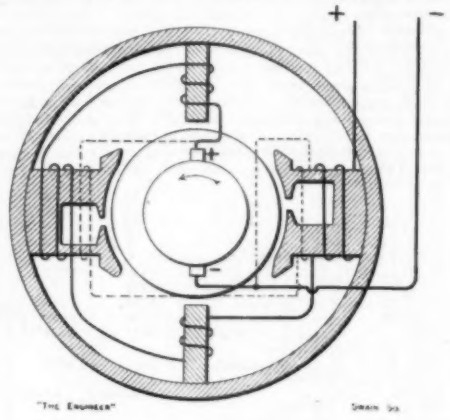


FIG. 6—FIELD WINDINGS

L *t* L *g* and will assist the polar flux on that part of the air gap which is under the trailing horn T *t*–T *g*. This cross magnetising effect of an armature is, of course, well known and is the cause of the distortion of the main field in ordinary dynamos and motors which leads to sparking at the brushes and is usually combated by making the field magnetisation relatively strong and the armature magnetisation relatively weak.

In this welding dynamo, however, use is made of this cross magnetising effect of the armature to give the necessary regulation as described in connection with Fig. 4. With a series winding only the machine would give a characteristic voltage-ampère curve starting with a very low voltage due to residual magnetism, with no current, rising to a maximum voltage determined by the constants of the machine and falling again to zero voltage on short circuit. When, however, a shunt winding is also added to assist the series winding, as shown in Fig. 6, the winding will give a characteristic voltage-ampère curve with a relatively high open circuit voltage and a drooping characteristic with a definite short-circuit current.

To sum up, the magnetomotive force of the series winding on a pole is opposed by the armature reaction magnetomotive force on the leading half of the pole and helped on the lagging half. If it is desired to arrange the dynamo to give no voltage—*i.e.*, short-circuit condition—at a certain current value, the flux entering the leading half of the pole face must be made equal to that leaving the lagging half of the pole face, and to obtain this condition at that current value the flux to the lagging half of the pole face is fed through a path that is highly saturated, and it therefore absorbs a large magnetic potential. If the current in the arc circuit tends to fall a slight flux difference will arise in favour of the lagging half of the pole face, and this difference creates an E.M.F. at the dynamo brushes, which in turn is augmented by the self-excitation of the dynamo.

A standard speed of 1440 revolutions per minute has been adopted, as this speed enables the dynamos to be directly coupled to direct-current or alternating-current, 25 and 50-cycle motors or high-speed petrol engines, whilst it is

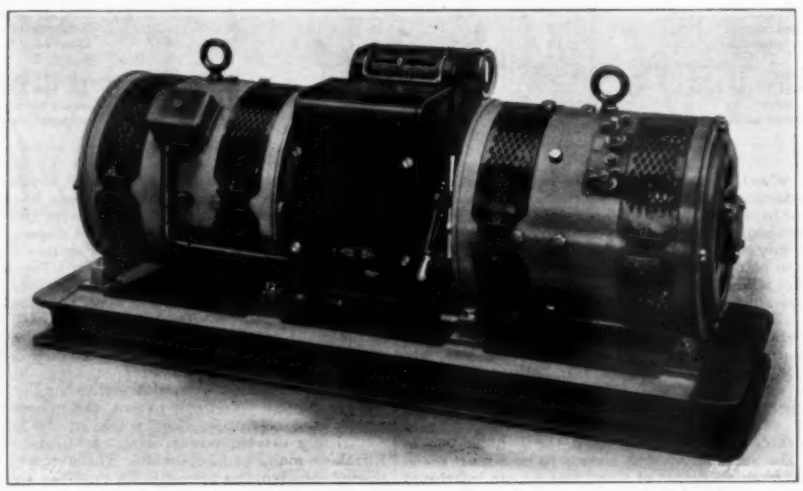


FIG. 5—MOTOR-DRIVEN DUPLEX MACHINE FOR TWO OPERATORS

1 unit. Under these conditions the flux entering the pole is equal to the flux leaving the pole, and consequently no voltage is generated in the armature, this being the short-circuit condition.

On open circuit, however, the magnetomotive force "*b*" due to the armature disappears and the magnetomotive force "*a*" is fully effective in sending flux into the armature through both pole horns, thus giving the open circuit voltage. But as the field coils are compound wound, as shown in Fig. 6, the magnetomotive force "*a*" on open circuit will not necessarily have the same value as on short circuit, but will depend on the relative values of the shunt and series turns adopted.

It is obviously unnecessary that the armature and field magnetomotive forces should balance one another at the point L *g*, the essential condition being that when the brushes are short-circuited the whole of the field magnetomotive force and part of the armature magnetomotive force should be taken up in forcing this flux "*f*" through

also very suitable for belt drives. Motor generator units as shown in Fig. 6 are self-contained and the motor starting panel and generator accessories are mounted as part of the unit so as to make the whole equipment portable, and, if necessary, the base-plate can be provided with wheels.

On account of the high efficiency, simplicity, light weight and few accessories required, these welding dynamos would appear to meet many requirements and should be less costly than more complicated machines now on the market.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Awaiting the Quarterly Meeting.

Business on the Birmingham iron and steel exchange this week has been on the quiet side, both producers and consumers being disposed to await next week's quarterly meeting of the trade before committing themselves further. The expansion of industrial activity in the Midlands and Staffordshire is maintained, and it is believed that some good orders will develop at that gathering. The previous quarterly meetings this year have brought forth little bulk business, but it is hoped this will prove an exception, and that consumers of iron and steel will see fit to cover, at least, their prospective requirements to the end of the year. Bulk orders to enable mills to run regularly on one class of material are much needed at the moment. With foreign competition much less effective than at any time this year, native makers of iron and steel are in a much better position to secure orders, and consumers, having noted the continued tendency of foreign prices to advance and supplies to become scarcer, are considered likely to pay more attention to native supplies than has been the case of late.

Steel.

In the steel department the position has not materially altered from last week. What change there may have been has been favourable to native steelmasters. The continued improvement in demand has resulted in still firmer prices, and in those branches where foreign competition has now become almost negligible, Midland steelmakers have been enabled, in favourable circumstances, to obtain slightly more remunerative prices. As an instance of this, one might mention the mild steel billet department. In this branch of the trade many consumers, who have previously depended upon imported supplies, have seen one continental source of supply after another dry up. Now German houses have intimated their inability to enter into further commitments, and users must perforce satisfy their requirements at home. Native makers who have profited by the stringency to fill their order books, are now quoting as much as £6 7s. 6d. for mild steel billets. The figure of £6 5s. about indicates the present level of the market. Small steel bars, both British and foreign, have appreciated correspondingly. With as much as £7 7s. 6d. asked for Belgian bars, mills at home have put up their quotations to £7 12s. 6d., £7 15s., and in some instances £8. A rise in continental joists has had no effect on British prices, which are controlled in that category and subject to the rebate scheme. Makers of steel strip for tube making are getting good business from the tube mills, several steelworks benefiting from the transfer of orders from foreign to home producers. All the steelworks are in a better position with the exception of the plate mills, which still need a good deal more work, shipbuilding being comparatively slow. Nevertheless, some good orders for plates have been received from structural and wagon-building interests. Constructional engineers are faring better, and plans for developments in the spring are taking shape, but actual business going at the moment is mostly of small dimensions. The electrical industry is rather favourably placed just now. An expanding demand for steel is reported in nearly all departments, and the outlook is encouraging.

Pig Iron.

The recent improvement in the pig iron department is just about maintained. Demand expands but slowly, but even such as it is it has made some inroads into furnace stocks. Some Northamptonshire blast-furnacemen have had the courage to endeavour to obtain a slight advance on their recent quotation of £2 15s. 6d. for No. 3 foundry iron. It is thought they have met with little success, however. Some Northamptonshire iron has been sold to the Middlesbrough area, and Cleveland producers complain that they are being undersold even at points where the transport rates are in their favour. How much of this business is coming to Northamptonshire makers it is difficult to discover, but certainly a portion of it is. The demand for foundry iron generally does not come up to expectations, while forge qualities sell in very small tonnages only. The quotations ruling at date are:—Northamptonshire foundry, £2 15s. 6d. to £2 16s. 6d.; forge, £2 12s. 6d.; Derbyshire foundry, £3; forge, £2 16s. Some East Coast hematite at £3 10s. has come into this district for mixing purposes. Rather more Welsh hematite is being bought at £4 2s. 6d. delivered. This iron is quite suitable for high-class castings which are sold in good quantities from South Staffordshire, this district being a recognised source of supply for the machinery used in the Welsh tin-plate trade. Speculation is rife as to whether next week's quarterly meeting will result in the giving out of forward contracts for pig iron.

Finished Iron.

Staffordshire mills rolling high grade iron are doing rather better, but lower grades of material continue in poor request. The iron trade in this district could well do with a stimulus. The marked bar houses are still fairly employed, but are not busy. The price is maintained at £12. For Crown iron Staffordshire makers ask £9 7s. 6d. but this price is cut by Lancashire and Derbyshire mills Few Staffordshire common bars are being used by th. nut and bolt trade here. They are far too expensive when compared with foreign material, yet No. 3 Belgian iron has since January jumped from £5 17s. to £7 2s. 6d. This is a very important change from the point of view of such Staffordshire industries as the nut and bolt trade, which has used much of this material. One result has been the substitution of steel for iron as the raw material, and one large nut and bolt firm is reported to have placed within the last week or so an order for 2000 tons of steel bars for nuts and bolts formerly manufactured from Belgian iron. The use of steel, however, necessitates a complete change of tools in manufacture. Tube strip sells moderately at from £10 15s. to £10 17s. 6d. District tube works are not so well employed as they were. Moreover, they are making up quite a large quantity of steel strip.

Galvanised Sheets.

Makers of galvanised sheets are, genrally speaking, in a happy position, being so well booked as to be able to command a substantial premium for prompt delivery. Demand is maintained, both on home and export account, and values are steady. £3 10s. is now regarded as the minimum price for 24-gauge corrugated sheets, with £3 15s. as the selling figure for urgent supplies. Prices of thinner gauges are unchanged. There is a slightly better call for black sheets from the automobile factories in this district.

Black Country Chain Trade.

Some very interesting facts regarding the chain and cable industry of the Black Country were mentioned by Mr. Percy Jump, of the Netherton Ironworks, in his Presidential address to the Staffordshire Iron and Steel Institute. The manufacture of chain in the Black Country, he said, represented about 90 per cent. of the total for the British Isles. It might be called a basic trade of this district, and employed approximately about 6000 hands. It was like the shipbuilding industry, suffering from a depression. The factory system of chain making, said Mr. Jump, was a modern development due to the advent of capital and enterprise. Formerly nearly every house built in parts of the district had its adjoining chain shop, but to-day the outwork section of the trade was very much reduced owing to the demand for better working conditions, the necessity for an increased size of plant, and better testing and inspection facilities. The growth of employment in the trade in that district was shown by the facts that in 1861 the total number of hands was 2896—2324 males and 572 females—and that in 1921 it was 5729—4491 males and 1238 females—while the total for England and Wales in the latter year was 6977. With reference to the trend of trade, he remarked that the export and import figures showed that while in 1927 there was an advance in export tonnage, the total, 16,238 tons, was only approximately half that for 1913. He asserted that the American trace-chain trade was killed by the American import duty, and pointed out that certain foreign countries and parts of the Empire who were good customers in pre-war days, were now themselves manufacturing and competing in our markets. While there had been indication of substantial loss of trade, he was optimistic with regard to the future, particularly when the world-wide character of the chain trade was realised and the demand for chains in engineering enterprises at home was considered. It was no idle boast to say that in no country in the world could chain be made superior to that manufactured in the area described as South Staffordshire and East Worcestershire.

Maintenance of the Severn Waterways.

Thanks chiefly to the efforts of the Bristol City Council, a satisfactory arrangement has been come to whereby the maintenance of canal communication between the Midlands and Bristol is assured for the next five years. It will be recalled that there was considerable prospect of the waterway becoming derelict, the Canal Company some time last year reporting that it was financially unable to maintain it. Authorities interested, including the City Councils of Birmingham and Bristol, and representatives of traders at both ends of the canal, investigated the question, but no agreement could be reached as to the nature of the financial responsibility of the respective districts. Bristol has not permitted the matter to drop, however, but has been instrumental in formulating an agreement between the Sharpness New Docks Company and an independent body of traders and interested companies in Bristol and the Midlands. This agreement makes provision for the establishment of a guarantee fund by the traders, which will operate over a period of five years, for the maintenance of the Worcester and Birmingham Canal. Industrialists in this area express gratification at the result, and many agree with the view expressed by the Birmingham authorities that the present position, whereby interested traders and others have made themselves responsible for the maintenance of canal communication, is the most satisfactory arrangement which could have been reached, and they hope the results of this experiment will justify a continuamce of the arrangement at the end of the present guarantee period.

South Staffordshire Mines Output.

In the annual report of the general manager of the South Staffordshire Mines Drainage Commission—Mr. E. Howl—it is stated that the mineral assessed for general drainage rates for the year ended December 31st last, included in the annual accounts to June 30th last, had been 1,180,234 tons, which represented at 1d. per ton a revenue of £4917. This was an increase in output of 14,896 tons, equal to £62 in rating value. There had been a decrease of 120,569 tons in the Tipton district, but the following increases in the other districts:—Oldbury, 28,186; Kingswinford, 94,184; Old Hill, 13,095; total, 135,465. The outlay upon maintenance works had been £1368, compared with £1370 the previous year.

Coventry Engineering.

The motor engineering industry in Coventry shows improvement and a better outlook develops as the Motor Show draws nearer. Employment increases week by week, and it is likely to continue. Important firms are getting well on to production with the new season's models, and, as output increases, more labour will be absorbed in the various departments.

Edge Tools.

The edge tool industry in this area, which is normally busy at this time of year, continues somewhat dull, the position in the East remaining rather obscure. South American markets, though recently showing an improvement, remain only moderately good, and orders from South Africa and Australia are poor.

1s. Per Ton Loss on Cannock Chase.

There was a loss of 12.72d. on every ton of coal produced in the Cannock Chase coalfield during August, and the owners' accumulated deficit now stands at £2,351,043. Miners' wages for October will continue at the same level as for many months past, namely, 42 per cent. on the 1911 basis, though the ability of the industry to pay is only 99·91 per cent., which is ·09 below the basis.

Unemployment.

Unemployment in the Midlands continues steadily to decline, and the past week witnessed a further fall in the number of registered unemployed of 2287. It is satisfactory to note that during the past month 20,841 hands have been reabsorbed into Midland industry. Whereas at the end of August the total for the area stood at 204,745, it is now down to 183,904. That business is improving this would clearly demonstrate. In the Birmingham area the month's reduction amounts to 1247, and at Coventry to 1678. In each of the Black Country areas, with the exception of Wednesbury, where there has been an increase of 189, there are fewer unemployed than a month ago, while at Stoke-on-Trent the total has fallen from 22,453 to 17,366. There has been a slight increase at Nottingham, and a small decrease at Leicester. The total unemployed in the Midlands are composed of 134,429 men, 4390 boys, 40,615 women, and 4470 girls.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

The Lancashire Coal Merger.

The scheme for the amalgamation of a number of Lancashire colliery concerns has widened its field since the proposals were first dealt with in this column six weeks ago. Originally it was proposed to amalgamate the Bridgewater Collieries, Ltd., the Astley and Tyldesley Collieries, Ltd., and Andrew Knowles and Sons, Ltd., three of the leading coal-mining concerns in the county. It is now officially announced that, as from October 1st, amalgamation arrangements have been concluded between Andrew Knowles and Sons and the Bridgewater Collieries, the amalgamation scheme also embracing the colliery concerns of John Speakman and Sons, Ltd., the Clifton and Kersley Coal Company, Ltd., and Fletcher, Burrows and Co., Ltd., and subsidiary undertakings of the constituent companies. Up to the time of writing the scheme does not embrace the Astley and Tyldesley Collieries, but an early and successful conclusion to the negotiations is expected. The principal economic advantage which, it is anticipated, will result from the operations of the new company—to be known as Manchester Collieries, Ltd.—will be economies effected on the selling side, one official expression of opinion being that there is no great prospect of saving much on actual production.

Air Port Scheme.

Some progress towards a definite scheme for the construction of an aerodrome in the Manchester district may be said to have been achieved during the past week. As a result of a conference arranged by the Lord Mayor and attended by a representative of the Air Ministry and by representatives of the leading commercial organisations of the city, a resolution was carried which recognised the need for such an aerodrome, and recommended the Corporation to "arrange for a suitable site being reserved for this purpose without further delay." The matter has since been before the Parliamentary Sub-Committee of the General Purposes Committee, and it is understood that the City Council will probably be asked to provide a suitable site at Wythenshawe, which is situated about seven miles from the centre of the city, where the Manchester Corporation owns an estate of 4000 acres.

A Development in Aeroplane Manufacture.

An arrangement has been entered into by A. V. Roe and Co., Ltd., aeroplane manufacturers, of Newton Heath, Manchester, with N.V. Nederlandsche Vliegtuigenfabriek, which makes Fokker aircraft, for the manufacture and sale in Great Britain, the Irish Free State, India, Australia, New Zealand, and other British Possessions, of a triple-engined Avro machine similar in construction to the triple-engined Fokker F 7. The arrangement has been entered into, it is explained, to save Messrs. A. V. Roe time and expenditure on research. The advantage of the new machine will be welded fuselage, which, until recently, has not been permitted in this country by the Air Ministry. Construction of the machines is to start shortly, but it will be some time before any of them are placed on the market.

A New Passenger Locomotive.

Beyer, Peacock and Co., Ltd., of Gorton, Manchester, have just completed the first of a series of ten new superheated six-coupled express locomotives. The engine is designed for use on the London and North-Eastern Railway system for hauling heavy passenger trains.

College of Technology Associates.

The first honorary associateships of the College of Technology, Manchester, were presented last Saturday

evening to Sir Henry Fowler, chief mechanical engineer of the London, Midland and Scottish Railway Company, and to Dr. S. Z. de Ferranti. At the presentation ceremony—the first of its kind in connection with the Manchester College of Technology—over 120 students were also presented as associates. Mr. B. Mouat Jones, the principal, said that of late years there had been an enormously increased demand from employers and employed for more and better facilities for technical and scientific training, and one of the most hopeful signs was that, in spite of the continued depression, the interest in and the volume and standard of technical training was increasing.

Conditions in Locomotive Engineering.

A reduction in the earnings of the company for the year ending June are disclosed in the balance-sheet of the Vulcan Foundry Company, Ltd., locomotive engineers, of Newton-le-Willows. The statement of the directors emphasises the facts that the capacity for production in the locomotive industry in this country and abroad is still far in excess of the present demand, and that keen competition for orders remains unabated. It is pointed out that the extensions to the works have been completed and have proved to be of great service. The net profit for the past year amounted to £70,506, compared with £76,779 in 1926–7, and £92,473 in 1925–26. In the two previous years the ordinary shareholders received a dividend of 10 per cent., but for the past twelve months a distribution on the ordinary shares of 8 per cent. is recommended. An interesting feature of the balance-sheet is that work in progress is valued at £192,379, compared with £137,495 a year ago.

Non-ferrous Metals.

Except for a further break in spelter, the other sections of the non-ferrous metals markets during the past week have experienced steady to firm conditions. Lead has been maintained, without any alteration on balance, at the prices ruling during the two previous weeks, with a slight advance in foreign metal compared with last report. It is not a matter for surprise that in the tin market the firmer conditions lately ruling have attracted more attention from speculative interests. The demand during the week has been fairly active, and notwithstanding a not unimportant increase in warehouse stocks in this country the previous week's gains have been consolidated, with foreign metal slightly dearer on the week and English unchanged at the advance last reported. The position of copper remains very strong, although prices are no higher than they were at this time last week. Consumption of the metal continues to improve, and more interest in forward buying by consumers is being shown. With regard to lead, the demand has been on a fair scale, and, as noted above, values keep steady. Only a moderate inquiry for spelter has been reported, and a further slight decline has occurred.

Iron and Steel.

Lancashire consumers of foundry iron who, during the summer months allowed stocks to get down, seem to be more readily inclined to buy, and several additional forward contracts have been reported on this market during the week, committments, in one or two instances, extending over the end of the current year. The result has been that makers have been able to maintain quotations without much difficulty, and there has been some speculation as to a possible firming up in consequence of the next quarterly meeting. In the meantime, Midland brands of pig iron —Staffordshire and Derbyshire—are quoted for delivery Manchester or equal at 67s. and 67s. 6d. per ton respectively, Middlesbrough No. 3 keeping firm at 79s., Scottish at from 87s. 6d. to 90s., and hematite at from 81s. 6d. to 82s., according to quantity, and including delivery to local users. There has been no change in bar iron, which continues in quiet request, with Crown quality offered by Lancashire makers at £10, and seconds at £9 10s. per ton. Buying of steel shows no expansion so far as forward buying operations are concerned, although a fair day-to-day rolling business is being placed. A further advance has taken place in quotations for small re-rolled bars on this market, current prices for them now ranging from £7 17s. 6d. to £8 2s. 6d. per ton, according to quantity. Locomotive plates keep steady at from £9 10s. to £9 15s., with general plates at £8 12s. 6d., sections at £7 17s. 6d., and large bars at £8 17s. 6d. Imported steel materials remain very firm for delivery here, notwithstanding a quiet local demand.

BARROW-IN-FURNESS.

Hematite.

The improvement in the pig iron trade in this district is being more than maintained. It was feared that the improvement might only be momentary, but there is evidence that the market is livelier than it has been for many months. There is a greater tendency on the part of buyers to order iron beyond their immediate requirements, and this is a welcome state of things after the hand-to-mouth policy which has been followed by customers for six or more months. There are eleven furnaces in blast in the district, and their output is practically covered by local and outside requirements. The steel works are taking a considerable amount of iron at Barrow. There is rather a better tone in the overseas trade and better business with the Continent is expected shortly in view of the stiffening of prices there. American business may develop but at present it is quiet. With a better demand there is the possibility of a hardening of prices. The present rates do not leave much if any margin. Local ore is in steady demand on a moderate scale, and business in foreign ores is quiet. In the steel trade orders held mean activity for some weeks and fresh orders are hoped for in the early future. The hoop mills are well employed. The small section mills are engaged and are likely to remain busy.

Shipbuilding.

The first of the three Chilian submarines was launched from the Vickers-Armstrongs yard at Barrow, on Tuesday, and the other two will take the water shortly. There have been no further contracts booked recently by the naval construction works at Barrow, but there are hopes of additional work being secured shortly. In the meantime there is a fair amount of work, including the two large repair ships for the Admiralty, an Orient Liner similar to the "Orford," a destroyer, and a number of submarines for the British and Chilian Admiralties.

SHEFFIELD.

(From our own Correspondent.)

Improving Steel Outlook.

ALTHOUGH the steel trades of Sheffield and district cannot report much evidence of a revival at present, there are some busy works, and also signs which give ground for confidence in the early future. Reports from other centres, suggest that the iron and steel trade is improving, and such improvement will no doubt reach Sheffield in due course, though the city is always one of the last places to benefit by an upward move. A good sign is the number of large contracts which have lately been placed in the country, and which will mean considerable employment for the iron and steel furnaces as their execution progresses. Another is the continuance of higher prices on the Continent, as a result of which users of cheap steels can now advantageously place their orders with home firms. Such orders have not yet been placed in any great bulk, but it is considered probable that they must come along soon, unless a reaction takes place in the continental markets, which is not likely.

Round the Works.

The position in Sheffield to-day is very mixed. Trade gains as well as loses ground week by week, and the city contains both busy works and very quiet ones. There is a good demand for cheap basic steel, but activity in the acid qualities is on a small scale. The works of the United Steel Companies at Templeborough, those of the Parkgate Iron and Steel Company, Vickers-Armstrong, and Metropolitan-Vickers are well employed, but at the other heavy establishments work and orders are short. The railway steel branch is in an unusually weak state. The British railway companies which cut down their specifications drastically a couple of months ago are still pursuing that policy. Only a moderate amount of foreign railway work is in hand, and the city's tire and axle plants are being subjected to long spells of idleness. There is very little being done in the building of wagons for private owners. The automobile builders and various industries requiring stainless and rustless steel are still good customers of the city. The position with regard to tool steels is unsatisfactory. Orders generally are for small quantities, and only a few makers are moderately employed. There is a good deal of slackness at the engineering foundries, and at most of the light foundries short-time working is the rule.

A Co-operative Export Plan.

The *Journal* of the Sheffield Chamber of Commerce reports that "our steel makers are busy with the organisation of a new export scheme. Naturally, the prime movers are reticent regarding their plans. We may say, however, that the scheme is co-operative in its principle, that it is bold in scope, and that it seems very promising when viewed in the light of successes and failures of previous steel trade schemes, both British and foreign. It is designed to do more for our trade in exports than the rebate scheme is doing at home. We venture to say that when the scheme is in full operation and its details come under the public eye, it will be recognised that our manufacturers have been wise to base their new co-operative move mainly on national or on British Empire lines, and to keep themselves clear of entangling international cartel alliances. National efforts are more calculated to restore our coal export trade and increase our share of the world's steel trade than anything our exporters can reasonably hope to obtain as mere units of international combines in which their protected competitors have the majority of the votes."

Some Good Orders.

One of Sheffield's well-known shipbuilding firms —that of Cammell Laird and Co., Ltd.—has received an order at Birkenhead for a 12,000-ton cargo liner for the Blue Star Line. The keel is to be laid down immediately. The vessel will be 485ft. long and 70ft. wide, and will be driven by steam turbines at a speed of 16 knots. She will be commissioned next spring for the South American chilled meat trade. The Brightside Foundry and Engineering Company, Ltd., Sheffield, has on hand a repeat order from Germany for a heavy type super-grinding mill. It has also just secured, in the face of keen competition, a contract for a large plant for the manufacture of bricks and sanitary pipes, to be sent to South America. In addition, it is constructing a machine which, says Mr. Ambrose Firth—a director of the company—will double the hourly output of the Norris machine, at present extensively used for brickmaking. Clayton Wagons, Ltd., of Lincoln, is constructing several twin-steam rail coaches for the Egyptian State Railways, and a trial run was given last week to one of these vehicles, which consists virtually of two carriages, with a trailer bogie at each end and a driving bogie in the middle. Over the Lincoln–Woodhall section of the London and North-Eastern Railway, a distance of about 16 miles, an average speed of 36 miles an hour was easily maintained, the maximum reached being 45 miles. The coach took the curves with great steadiness.

Spanish Tariff on Files.

There is little change to report in the tool branches generally. Although the output is large, it is not sufficient to ensure full employment all round, and there is consequently much slackness and keen competition. Orders for small oddment lots are growing, and cause considerable inconvenience. There has been a further decline in the demand for files, and there is a great deal of short-time working at the factories, one or two of which have been, in fact, stopped altogether for a week or more at a time. The serious blow to the Spanish trade in files, threatened by the proposed heavy increase in tariffs, is regarded with much anxiety in the city. A meeting of protest was held by the Chamber of Commerce on Monday. It was stated that the present value of the city's trade in files with Spain was £30,000 a year, and it was feared that the suggested new duties would have the effect of destroying this trade. A strong resolution was passed, not only protesting against any increase, but expressing surprise at the reported intention of the Spanish Government, in view of a statement made by the Spanish Ambassador in London on March 12th last, when he said, "I am authorised to say that it is not the Spanish Government's intention to impose heavier customs duties on metal goods of any sort."

Cutlery and Plate.

There is an improvement in the booking of orders for cutlery and plate, on both home and export account, but, while several of the houses are benefiting from this, it is not general, and the aggregate volume of business is not up to the level expected at this time of year. The Christmas season trade does not at present appear likely to reach the average. The demand for low-priced goods continues to represent an increasing proportion of the whole and the number of makers is so large that price-cutting is severe. In many cases, costs of production are being reduced by the employment of boys and girls to dilute skilled labour, and there is also a growing use of machinery for grinding and various minor processes. The sixpenny bazaars are large customers for cheap cutlery. A number of good orders have lately been placed for silverware and high-quality electroplate.

Record Pig Iron Output.

It is pleasing to note in these dark days that a company has been breaking records in the production of pig iron. Such a company is the Staveley Coal and Iron Company, which gives a very satisfactory report of conditions at its Devonshire Works, Staveley, during the year ended June last. No. 2 furnace has been relined, and was set to work again in April, and the relining of No. 4 furnace is now completed. The total output of pig iron for the year was 166,076 tons, as against the previous record in 1924–5 of 142,400 tons. The coke oven plant also showed a record output, the total make being 246,842 tons, as against 243,925 tons in 1924–5. The whole of this coke was used in the company's furnaces. A record was also set up by the foundry, which, in spite of the keen competition in the trade, produced a tonnage exceeding the previous best by about 1200. It was busy in making special castings. The company has laid down a plant for lining iron pipes with concrete, and this has just commenced work, with satisfactory results. The associated firm of Markham and Co., of Chesterfield, has on hand some good orders for colliery machinery for overseas, including one for winding engines for the Cape of Good Hope.

New Works.

There are several interesting items of news this week with regard to the establishment of new works in Yorkshire. It is officially announced by a sub-committee of Doncaster Corporation that the British Bemberg Company, Ltd., artificial silk manufacturers, has provisionally made arrangements for the purchase of a site of 60 acres from Sir William Cooke at Wheatley. It is understood that as soon as other details have been setted a start will be made with the erection of a factory, which will provide employment for 1500 people. The Distillers' Company, Ltd., has acquired a site of 32 acres at Salt End, Hull, on which to erect a factory for the manufacture of commercial alcohol, which will be one of the largest in the world. The work of constructing the factory and laying roads has been commenced. The Blackburn Aeroplane and Motor Company, which at present has its constructional works at Leeds and an aerodrome and factory at Brough, on the Humber estuary, has decided to concentrate all its operations at Brough. It is expected that the transfer will be completed by next spring, after which the whole of the firm's manufacture of aeroplanes and flying boats, for both commercial and Air Force purposes, will be carried on at Brough. Thorncliffe Distillation, Ltd., has undertaken the erection of a central battery of coke ovens at Smithy Wood, about 4 miles from Sheffield. The coal will be supplied from the collieries of Newton, Chambers and Co. A contract has been made with the Sheffield Gas Company for the supply of a substantial amount of gas per diem.

NORTH OF ENGLAND.

(From our own Correspondent.)

Export Trade Still Declining.

THE marked falling off in the extent of foreign competition, and the disposition of continental producers to hold out for higher prices, do not seem to have diverted any substantial amount of business to iron and steel manufacturers in this district. There are now only twenty-nine blast-furnaces operating in the North-East Coast area—less than one-third of the number available—and both steel outputs and shipments are substantially reduced. The statistics of the export trade of the Cleveland district for September reveal a disconcerting contraction in the volume of overseas trade. Aggregate shipments of all classes of iron and steel, which reached 75,436 tons in July and 81,993 tons in August, fell to 67,303 tons in September, which ranks as the worst month of the year. Pig iron was responsible for a drop of about 1000 tons, this being due to a decline in the coastwise shipments, but manufactured iron and steel exports fell from 62,985 tons in August to 49,257 tons in September, the contraction being most marked in the exports to India. Scotland was, as usual, the largest buyer of pig iron, with 7708 tons; while Italy took 2100 tons, Wales 1708 tons, Canada 1643

tons, and Germany 1140 tons. The chief purchasers of steel were India 12,116 tons, Argentina 4616 tons, New Zealand 3650 tons, Japan 2716 tons, and Australia 2252 tons.

Imports Down.

Imports of pig iron and manufactured iron and steel, on the other hand, continue to show a welcome falling off. Statistics presented at this week's meeting of the Tees Conservancy Commissioners reveal that for the eleven months ending September 30th, 208,533 tons of pig iron and steel were imported, compared with 354,773 tons for the corresponding period of 1926–27, and 54,563 tons for the pre-war years 1913–14. .During the past month 16,579 tons of material were received, consisting of 12,845 tons of crude sheet bars, billets, blooms, slabs, &c.; 1320 tons of pig iron; and 2414 tons of plates, bars, angles, rails, sheets and joists. In September last year 20,925 tons were imported, and in 1914 1164 tons.

Cleveland Iron Trade.

The volume of business passing in the Cleveland pig iron trade falls short of expectations, but expansion during the current month is rather confidently looked for. Makers adhere firmly to their fixed prices, notwithstanding the comparative cheapness of Midland iron and the consequent purchase of the latter by certain firms which usually take their supplies from the Cleveland district. Stocks of Cleveland iron are low, and the output is far from heavy. Makers are consuming a large proportion of the production at their own foundries and steel works. No. 1 foundry iron is 68s. 6d.; No. 3 G.M.B., 66s.; No 4 foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

The steady home and continental demand for East Coast hematite pig iron, while not large, is more than sufficient to absorb the production, and stocks are still being drawn upon. Makers are in a stronger position than for some time past, and values are stiffening, but prices are still well below cost. Ordinary brands are firm at 70s., and some producers are inclined to hold out for rather more.

Ironmaking Materials.

Foreign ore deliveries against old contracts are fairly large, but new transactions are few. Values are upheld on the basis of best Rubio at 22s. 6d. c.i.f. Tees. Durham blast-furnace coke is in only moderate request for local consumption, but producers are well sold for export, and values show an upward tendency. While orders for good average qualities can still be placed at 17s. 6d., delivered to works in this area, some sellers are asking as much as 18s.

Manufactured Iron and Steel.

Finished iron and steel manufacturers are in a better position than for some considerable time past, but a quickened buying movement in some branches would be welcome. Prices are unaltered.

The Coal Trade.

There is a little brighter tone in the Northern coal trade. Fitters in all grades are quoting steadier under better-filled order books, and with tonnage more plentifully stemmed, prices are tending upwards. Northumberland has done better out of the Belgian State Railways' inquiry than was at first thought likely, having regard to the widespread character of the competition. Altogether, the allocations for this area amount to 40,000 tons. Yorkshire collieries are believed to have got orders for 10,000 to 15,000 tons, and it is considered probable that the remainder of the contract—about 30,000 tons—has gone to Belgian collieries. Northumberland steam coals have a very steady appearance, and the output is fully booked up. Values are firmly held at 13s. 6d., with seconds at 12s. Small steams are in good demand, ordinary being 8s. 3d., best 8s. 6d. to 9s., and specials 9s. 6d. Durham gas coals show little movement, but fitters regard the outlook as brighter in view of the ending of summer-time, combined with the present colder spell of weather. Supplies are offered freely, but are quoted steady; best qualities at 14s. 9d., and seconds at 13s. 3d. to 13s. 6d. The coke trade is firm, and the demand shows general expansion. Tonnage for this month has been plentifully stemmed, and orders are being rapidly booked up. Gas coke is quoted firmer at 19s. 6d. to 20s., while patent oven cokes are fully steady at 18s. 6d. to 19s., and beehive at 24s. to 28s.

Coal Trade Proceeds and Costs.

The coalmining industry in the North of England remains in a very unsatisfactory economic position. The latest ascertainments concerning the proceeds and costs indicate a slight improvement in Northumberland, but none in Durham. The joint report of the accountants in regard to Northumberland shows that the proceeds and costs in August, which would regulate wages in October if there were no minimum addition to basis rates, would provide for wages at a rate of 5·28 per cent. less than the basis. This compares with minus 10·18 per cent. in September, so that there is an improvement of 4·90 per cent. The county minimum on the basis is 40 per cent., so that the owners in the current month have to make up 45·28 per cent. In Durham the accountants' joint report shows that wages this month would be 20·02 per cent. on the basis. In September the percentage addition was 21·72 per cent., so that there is a reduction of ·50 per cent. The minimum percentage on the basis is 65, so that the owners are called upon to make up a deficiency of 43·98 per cent.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

DURING the month of September thirteen vessels of 69,620 tons aggregate were launched from Clyde yards. The returns for this year to date amount to 160 vessels of 485,823 tons, which is within 4000 tons of being a record for the period, and has only been exceeded in the years 1913 and 1920, since 1904, excluding the war years. Two vessels accounted for more than half of the September totals:—"Duchess of York," twin-screw turbine, 20,500 tons, built for Canadian Pacific Steamships, Ltd.; "Viceroy of India," twin-screw, turbo-electric liner, 19,300 tons, built for the P. and O. S. N. Company, Ltd. New contracts reported during September were disappointingly small, and with outputs continuing on a high level, the outlook for the winter months is not improving.

Steel.

Steelmakers maintain a more hopeful attitude in view of the appreciation in price of competitive foreign material. Actual business continues quiet, however, despite a fair inquiry, especially in respect to heavy steel, demands for which have fallen off within the past week or two. Steelmakers are comparatively well placed, especially those engaged on thin gauges. Galvanised corrugated sheets are very firm at present. Heavy sheets are not particularly well off, though here and there some fair orders are on hand. Makers, too, find some difficulty in securing advances in prices commensurate with the advance in raw materials.

Iron.

Bar iron continues dull and short time is the rule at the works engaged. Producers of rerolled steel bars are, however, benefiting from the increased prices, and extended deliveries of continental material. Increased demands are reported for locally produced tube hoops and strips.

Pig Iron.

Demands for pig iron are not improving, and the production of the twenty-one furnaces in blast is more than ample to meet all requirements.

Tubes.

Tube makers employed on butt-welded and seamless tubes are comparatively busy. Lap-welded tubes are in poor request, however.

Exports and Imports.

During the past week 4400 tons of iron ore, 1600 tons of steel and iron, and 100 tons of pig iron were discharged at Glasgow Harbour. Within the same period exports included 6600 tons of steel and iron and 260 tons of pig iron.

Coal.

So far as exports are concerned no improvement is noticeable in the Scottish coal trade. Inquiries are moderate, but shippers find difficulty in inducing foreigners to concede the prices asked. Lanarkshire splints are comparatively well placed, and ells are booked a week or two ahead. Lothians steams are barely firm. Fifeshire prime steams have a fairly steady outlet, while third-class qualities are well sold at current prices. Washed nuts are firm in all districts. Aggregate shipments amounted to 249,175 tons, against 240,269 tons in the preceding week and 248,984 tons in the same week last year. Household coal is dearer to the extent of 1s. to 1s. 6d. per ton.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

IT would be idle to pretend that there is any material improvement in the steam coal trade. The position of the majority of collieries has not undergone any betterment, notwithstanding expectations in view of recently expanded chartering. The fact is that the tonnage has not come along in anything like the quantity that is required to impart real activity, and colliery salesmen are experiencing a very dull time from the point of view of new inquiry. For the week ended the 28th ult., the volume of tonnage taken up reached just over 390,000 tons, which is the highest figure since the week ended January 13th last, but one hesitates to hold out much hope of collieries feeling appreciable benefit judging from past experience, though if this rate of chartering could be maintained, the outlook would certainly be better. Last week shipments turned out to be very disappointing, as the total came to only 316,819 tons, which was a severe decline as compared with the previous week, when the quantity came to over 464,000 tons. The direction for which shipments showed the most falling off was South America, as the reduction came to no less than about 54,000 tons. While current business keeps very quiet, operations have been concluded for delivery over a period. The contract for 100,000 tons of small coals for the Portuguese State Railways for delivery at Lisbon, Oporto and Villareal from mid-October to mid-February has been divided between Gueret, Llewellyn and Merrett, Ltd., and Pyman, Watson and Co., Ltd. So far as is known, the order for the Swedish Navy for 27,000 tons of Admiralty large coals has not been placed for Welsh coals, but the French Marine has bought 10,000 tons of large, and it is now reported that one of the French railways is asking for prices for 60,000 tons of large and small coals for delivery over next year.

Coalfield Items.

A test of whether conditions in the coal trade are better is the state of employment in the coalfield. Unfortunately, when it is applied, the result is not very favourable, though, of course, it is not always safe to generalise from a few particular instances. The fact remains that as a consequence of the depression prevailing, 2400 men employed in pits belonging to the Tredegar Iron and Coal Company in the Tredegar and Blackwood district, received at the end of last week notices to terminate their employment, and this week over 2000 men engaged at the Naval Collieries, belonging to the Cambrian Combine, who a fortnight ago received similar notices, are now idle, and it is reported that these pits are to be closed down indefinitely. In the case of the Tredegar pits, there is, however, just a chance that the notices will not in all cases take effect, and it is quite probable that many of the men will be found employment at other collieries belonging to the same undertaking.

Ship-repairing Industry.

During the past week or two ship repairers in this district have had a very quiet time. For one time, the fact that outward rates of freight have improved has meant that many shipowners have deferred having repairs executed as far as possible, while, furthermore, tonnage generally has been scarce, and many dry docks have been empty for quite a number of days in the week. The news that there is a strike of workers in the German shipyards has roused hopes that this will react to the advantage of South Wales repairing firms.

New General Cargo Line.

Sir W. R. Smith and Son, Ltd., of Cardiff, the well-known shipowners, have announced the establishment of a new general cargo service, from the Pacific to London and Liverpool, and if it is found that sufficient cargo is offered, it will be extended to Manchester. One vessel per month will be employed on this line, commencing with the motor ship "East Lynn," the ss. "King City," and the motor ship "West Lynn," in the order named. The firm has opened new branch offices at Vancouver, Seattle, Portland (Oregon), and San Francisco. Cargoes carried will include dry fruits, lumber, and copper.

Current Business.

The general tone of the steam coal market remains very quiet and featureless. Some colliery salesmen describe the position as being as dull as conditions ever were. Certainly the demand for coals appears to be very quiet, though exporters must hold a fair number of orders, as rates of freight are well upheld, in spite of the fact that the tonnage on offer for employment does not show any reduction. It is not surprising that so far as prices are concerned, there is no alteration, and it is only in the case of sized coals and some smalls that values can be described as at all steady. Coke of the superior grades meets with a brisker demand, and patent fuel makers are slightly better engaged. Pitwood has been up to 37s. 6d. as a result of the restricted supplies available, owing to the strike of dock workers at Bordeaux. This strike, while affecting the loading of pitwood, has not held up the discharging of coal cargoes quite to the same extent. Naturally, collieries are keeping their purchases of pitwood down to the minimum, in view of the quotations prevailing. The price asked by sellers is now round about 36s. ex ship.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Midland Ironworkers' Wages.

WAGES of ironworkers in the Midlands which are regulated by a sliding scale under the Midland Iron and Steel Wages Board are, as the result of the ascertainment, to be reduced by 2½ per cent., as from Monday next, October 8th. The award remains operative until December 1st. Wages will now be 27½ per cent. above the puddling base rate of 13s. 6d. The total reduction in the plussage this year now amounts to 7½ per cent.

CONTRACTS.

EDWARD BENNIS AND CO., Ltd., during the past three months have secured eight contracts for mechanical chain grate stoker equipments for water-tube boilers; eight for mechanical stoking equipment for Lancashire boilers; and eleven for mechanical coal and ash-handling plants.

JOHN I. THORNYCROFT AND CO., Ltd., have received a repeat order from the Kowloon Omnibus Company, of Hongkong, for four of their 32-seated forward-control low-loading omnibus chassis, which are to be fitted with locally built bodies. These vehicles have been ordered through the firm's Hongkong office.

LAUNCHES AND TRIAL TRIPS.

MARIE FELLING, twin-screw steam berthing tug; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of Crown Agents for the Colonies, for work in the Port of Mombasa in the Colony of Kenya; launch, September 27th.

CREOLE JEFE, twin-screw oil tanker; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of Sir Joseph W. Isherwood and Co., Ltd.; trial trip, September 28th.

THE ENGINEERING GOLFING SOCIETY.—The autumn meeting of the Engineering Golfing Society was held at Moor Park, Rickmansworth, on Wednesday, September 26th. In the morning there was an eighteen-hole medal round, and the "Hele-Shaw" Scratch Challenge Cup and Memento were won by G. H. Hopewell, with a score of 83. The handicap prizes were taken as follows:—First Division (handicaps 10 and under): first prize, J. B. Marr, 86 — 9 = 77; and second prize, H. E. Midgley, 88 — 7 = 81. Second Division (handicaps 11 and over): first prize, H. C. Siddeley, 91 — 12 = 79; and second prize, P. B. Brown, 93 — 13 = 80. The "P. B. Brown" Challenge Cup, for the best net score in either division, was taken by J. B. Marr. The prize for the best first nine holes fell to A. B. Steele, and the prize for the best second nine holes to W. L. Mansergh. In the afternoon there was an eighteen-hole round, foursomes against bogey, when the "Hadfield" Challenge Cups and Mementoes were won by G. Waterhouse and Alan Williams with all square; the second prizes going to E. C. MacKellar and Walter Phillips with 4 down. There were forty-six competitors.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	18/6 to 21/6
(1) Spanish	18/6 to 22/6
(1) N. African	18/6 to 22/6
N.E Coast—	
Native	18/– to 21/–
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 11 0	3 11 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 15 6 to 2 16 6	—
Forge	2 12 6	—
(3) Derbyshire—		
No. 3 Foundry	2 19 0 to 3 0 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	2 19 0	—
No. 4 Forge	2 17 6	—
Basic	2 19 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 2 0 (*a*); 4 4 6 (*b*); 4 8 0 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 15 0 to 9 0 0	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¾in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0	13 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	7 10 0 to 10 0 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 17 6 to 8 2 6	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 5 0 to 6 7 6	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands		
Small Rolled Bars	7 12 6 to 8 0 0	—
Billets and Sheet Bars	6 5 0 to 6 7 6	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 12 6	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/1¼ to 18/4½
Block Tin (cash)	222 17 6
,, (three months)	220 5 0
Copper (cash)	64 10 0
,, (three months)	64 17 6
Spanish Lead (cash)	22 1 3
,, (three months)	21 17 6
Spelter (cash)	24 2 6
,, (three months)	24 8 9
Manchester—	
Copper, Best Selected Ingots	69 10 0
,, Electrolytic	72 0 0
,, Strong Sheets	96 0 0
,, Tubes (Basis Price), lb.	0 1 1¼
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2¼
Lead, English	23 12 6
,, Foreign	22 0 0
Spelter	24 12 6
Aluminium (per ton)	£107

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/–
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/–
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/–
,, ,, ,, 1 p.c. carbon	£37 0 0	15/–
,, ,, ,, 0·70 p.c. carbon	£41 0 0	17/–
,, ,, ,, carbon free	1/– per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/– per unit
,, ,, 75 p.c.	£19 0 0	scale 6/– per unit
,, Vanadium	14/– per lb.	
,, Molybdenum	4/– per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/– per lb.	

FUELS.

SCOTLAND.
(*Prices not stable.*)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	15/6
,, ,, Splint	15/9 to 16/9
,, ,, Trebles	13/6
,, ,, Doubles	13/3
,, ,, Singles	12/–
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	13/9
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	11/– to 12/9
Screened Navigation	18/–
Trebles	14/9 to 16/–
Doubles	13/3 to 13/6
Singles	12/6
Lothians—	
(f.o.b. Leith)—Best Steam	12/3 to 12/6
Secondary Steam	11/9
Trebles	14/–
Doubles	13/3
Singles	12/6

ENGLAND.

	Inland.	Export.
(8) N.W. Coast—		
Steams		25/6
Household		38/6 to 51/–
Coke		22/6 to 23/6
Northumberland—		
Best Steams		13/3 to 13/6
Second Steams		11/9 to 12/–
Steam Smalls		9/– to 9/6
Unscreened		11/9 to 12/–
Household		21/– to 27/–
Durham—		
Best Gas		15/–
Second		13/3 to 13/9
Household		21/– to 27/–
Foundry Coke		18/3 to 19/–
Sheffield—		
Best Hand-picked Branch	26/– to 27/6	—
Derbyshire Best Bright House	21/– to 22/6	—
Best House Coal	19/6 to 20/6	—
Screened House Coal	16/– to 17/–	—
,, ,, Nuts	14/6 to 16/–	—
Yorkshire Hards	14/6 to 16/–	—
Derbyshire Hards	14/6 to 16/–	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/–	—
Smalls	3/– to 4/6	—
Blast-furnace Coke (Inland)	13/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/– to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/– to 19/–
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/ to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/– to 17/3
Best Eastern Valley Large	16/6 to 17/–
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/–
Ordinary Smalls	10/6 to 12/–
Washed Nuts	16/6 to 18/6
No. 3 Rhondda Large	19/6 to 20/
,, ,, Smalls	14/– to 14/6
No. 2 ,, Large	16/– to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	12/6 to 13/6
Foundry Coke (export)	27/– to 36/–
Furnace Coke (export)	19/– to 21/–
Patent Fuel	20/6 to 21/6
Pitwood (ex ship)	33/– to 35/–
Swansea—	
Anthracite Coals :	
Best Big Vein Large	34/– to 35/6
Seconds	24/6 to 27/6
Red Vein	20/6 to 27/–
Machine-made Cobbles	40/– to 43/6
Nuts	35/– to 43/6
Beans	23/6 to 26/–
Peas	18/– to 18/6
Breaker Duff	8/– to 8/3
Rubbly Culm	11/– to 11/3
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/– to 17/–
Smalls	10/– to 12/6
Cargo Through	15/– to 16/–

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/– extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Deliverd Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate 12/6 joists and 10/– all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Rationalisation.

THE system of "rationalisation," which has come to be regarded in Germany as the essential basis of industrial prosperity, finds much less scope in France where the engineering industries do not usually permit of a close specialisation in production. The sales of engineering products abroad are not considerable, and manufacturers therefore depend upon the home and colonial demand, which is large and varied. This does not enable firms to lay themselves out for the economical production of particular classes of goods, because the quantities are not sufficient for the purpose, and they are, moreover, too often tied down to specifications which involve changes in a particular class of product. Nevertheless, French manufacturers accept the principle of "rationalisation" in a limited sense, though while offering obvious advantages in the case of industries producing largely for export, it can only have a restricted application in the great majority of engineering trades. Its influence is seen in a gradual standardisation of parts in universal use and in a simplification of types. The French have done a great deal of late years in the way of simplifying and cheapening production. In some essentially French industries specialisation has been carried out as far as it is possible to go in the way of increasing output and getting down costs, but the engineering trades do not offer the same opportunities because they have, for the most part, to supply a limited home demand. Nevertheless, the system of "rationalisation," so far as it means a division of work amongst firms which are the best equipped for turning it out under economical conditions and the centralisation of their buying and selling services, has some chance of being adopted in one or two industries which are threatened with serious foreign competition. It is expected that something will be done very shortly in the motor car industry. French makers are seriously alarmed at the threatened competition from the United States, and several leading firms hope to meet it by settling upon satisfactory basis of co-operation whereby costs will be reduced and an organised effort can be made to preserve the home market. All attempts at such collaboration have so far failed, but the situation has since become so serious that an early satisfactory issue of the negotiations is believed to be quite possible. The same tendency is observable in the machine tool industry.

Aviation.

Aviation is believed to have entered upon a new era of development with the creation of the Minister of Air and the appointment to that office of M. Laurent Eynac, who has succeeded, after great trouble, in overcoming the opposition of his colleagues of the army and navy to his being invested with entire control over the air services. The estimates will be prepared in common with the Minister of War and the Minister of Marine, but they will be disposed of by the Minister of Air, who will be solely responsible. He will have everything to do with the designing and construction of machines in accordance with the requirements of the naval and military departments, and he will supply those services with the material they need as well as the pilots and mechanics. The army and navy authorities will control the strategical utilisation of the air force. All else is in the hands of the Minister of Air. In civil aviation he will have complete authority, and he is credited with the intention of carrying out an extensive organisation covering systems of home air lines in conjunction with the international lines. The services with European centres will be improved and extensions will be made to Indo-China and Africa. The French place entire confidence in M. Laurent Eynac, but it is admitted that he is confronted with a formidable task.

Rural Water Supply.

Of the 36,000 communes in France scarcely 10,000 possess a suitable water distribution. Except in the towns the water is obtained from wells and cisterns that offer no guarantee of purity and are, in fact, a constant source of danger, and, as it has become a national policy to improve the living conditions in the country and check the continued migration of the rural population into industrial centres, this question of water supply is beginning to attract considerable attention. It is obvious that the provision of facilities in the way of light and energy by the carrying out of the rural electrification scheme will fail to give the desired result unless the scheme is accompanied by other measures which aim at bettering the condition of the agricultural workers. The problem of the water supply is sufficiently vast to monopolise the activities of water engineers for a considerable time to come if it can be solved in a satisfactory manner. Subsidies granted by the State to the communes for local improvements can be used for water installations and the funds can be supplemented by loans, so that there do not appear to be any serious financial difficulties in the way. The propaganda now being carried out aims at convincing the communes of the necessity of utilising technical knowledge in the selection of sources and the laying down of suitable plants. There is probably scarcely a commune in which, with the use of a small and efficient plant, it would not be possible to ensure a distribution of water of as good and even better quality than that supplied in towns. During the last year or two, large sums of money have been spent upon supplying water to communes that had suffered from water famine in times of drought, and it is now recognised that something must be done to ensure the quality of the water used by the great majority of the communes.

Pig Iron Production.

During the third quarter of the year the average monthly production of pig iron was 845,000 tons, as compared with 774,000 tons during the same period of 1927. The number of furnaces in blast at the end of August was 149, or five more than a year ago. The average monthly production of steel during the same period was 780,000 tons, as against 689,000 tons in the first three months of last year. In the former total Thomas pig accounted for 549,000 tons.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

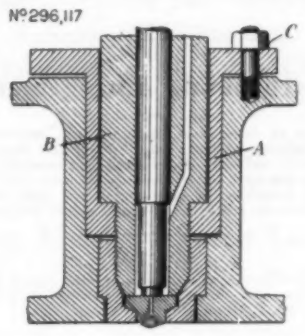
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

296,117. May 25th, 1927.—FUEL VALVES, T. V. Hemmingsen, Ove Billes Tvaervej 4, Copenhagen, Denmark.

This fuel valve, it is claimed, avoids the difficulties which are experienced with some valves in the way of the maintenance of tightness, which, it is explained, may be caused by the force actually employed with the intention of producing that tightness. The essential idea of the invention is the reduction of the

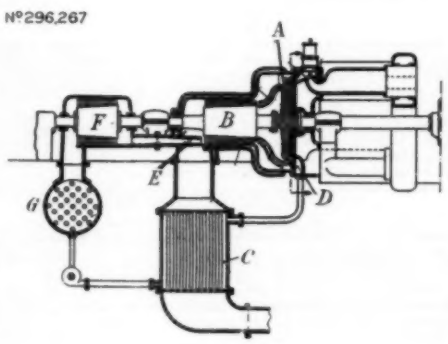


length of material subjected to the clamping force, so that any distortion is minimised and localised. This object is attained by effecting the clamping of the several parts of the spray by the sleeve A which is screwed on to the lower part of the valve chamber B and is held down to the cylinder cover by the studs C. It will be seen that the application of the holding force to the valve chamber is as near as is possible to the abutment.—*August 27th*, 1928.

TURBINE MACHINERY.

296,267. June 23rd, 1927.—COMPOUND GAS TURBINES, Holzwarth Gas Turbine Company of America, 504, Standard Oil Building, 225, Bush-street, San Francisco, California; and H. Holzwarth Engelburtusstrasse 110, Mulheim-Ruhr, Germany.

In this gas turbine the products of explosion are first employed in the high-pressure turbine A and then in the intermediate turbine B. They are exhausted through the boiler C, which

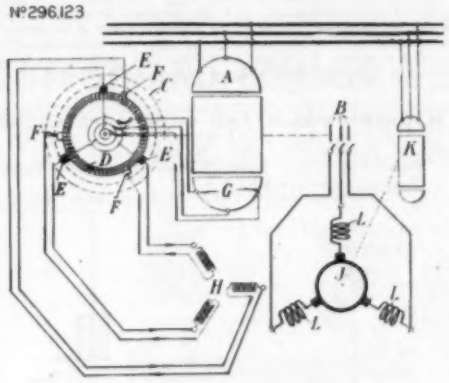


supplies steam to the nozzles D. This steam helps to cool the blading of the high-pressure turbine and its exhaust is collected separately from the exhaust gases, to be subsequently used in the intermediate turbine. The exhaust steam is again collected separately at E, is expanded in the low-pressure turbine F and condensed at G. The specification gives appropriate pressure drops through the several stages for both gas and steam.—*August 30th*, 1928.

DYNAMOS AND MOTORS.

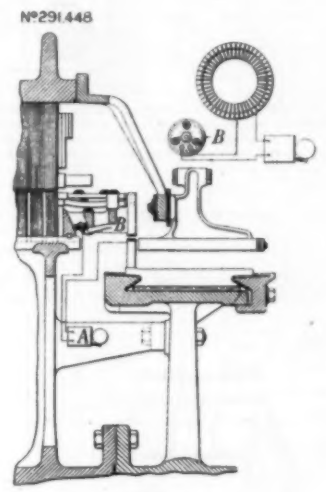
296,123. May 26th, 1927.—SPEED REGULATION OF ASYNCHRONOUS MOTORS, Claudius Shenfer, of the Moscow Technical High School, 8t. Basmannaja-street 15, Moscow, Russia; and The English Electric Company, Ltd., of Queen's House, 28, Kingsway, London, W.C. 2.

This specification describes a method of automatically regulating the speed of an asynchronous motor as the load on the motor varies. The primary winding A of the asynchronous motor is connected to the mains and the rotor is joined to slip rings B. This rotor is mechanically coupled to the rotor of the frequency converter having an unwound magnetic stator structure C of uniform reluctance. The rotor has a winding D connected to a set of slip rings, the bushes of which are connected to the supply mains by way of the primary winding on the stator and to a commutator with two groups of brushes E and F. The star point of the winding is opened in order to provide the connections G. The set of brushes E is fixed whilst the set F is movable. A three-phase commutator machine with a stator H and a wound rotor J is mechanically coupled to a second synchronous machine K which is electrically connected with the supply mains, and this machine can serve as a motor or generator as the conditions of operation require. The stator windings H are connected across a pair of brushes E F. The rotor J is provided with a commutator and brushes which are connected through compensating windings L to the slip rings B of the motor to be regulated. In order to obtain the desired speed at some particular load the brushes F are placed at a certain point in relation to the set brushes E. If the load increases the current in the secondary winding of the motor also increases and the voltage absorbed by the primary winding decreases, so that the voltage applied to the winding D of the frequency converter increases. This results in an increase in the excitation of the auxiliary commutator machine H J and a consequent reduction in the speed of the main synchronous motor.—*August 27th*, 1928.



291,448. May 25th, 1928.—IMPROVEMENTS IN OR RELATING TO TEMPERATURE INDICATING SYSTEMS FOR DYNAMO-ELECTRIC MACHINES, *Metropolitan-Vickers Electrical Company Ltd., of 4, Central-buildings, Westminster.*

An electric bell A is provided to give warning when the temperature of the machine becomes excessive. The bell may be energised by a source of low voltage by connecting it to predetermined points on the armature of opposite polarity, and in

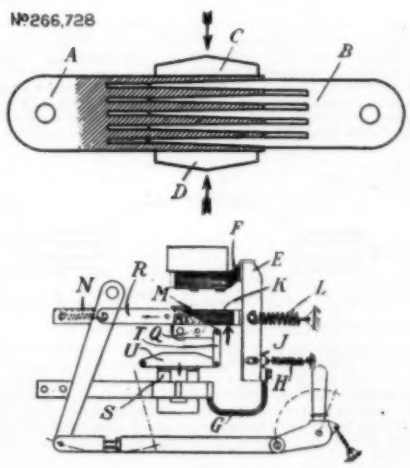


order that the bell may be energised when the temperature reaches a predetermined value a thermo-responsive device or thermostatic switch B is provided. As long as the temperature of the armature remains below a certain value the thermostatic switch interrupts the circuit, but when the temperature reaches a predetermined value the circuit is closed and the electric bell rings. The thermostatic switch forms the subject of another invention, Patent Specification No. 178,103.—*August 30th*, 1928.

SWITCHGEAR.

266,728. February 23rd, 1927.—IMPROVEMENTS IN AND RELATING TO OVERLOAD CIRCUIT BREAKERS, Voigt and Haeffner Aktiengesellschaft, of Frankfurt-on-Main, Germany.

In the manufacture of quick-acting switches it is of great importance to employ coupling devices requiring a short period of time to disengage. In the drawing A and B are two parts to be coupled together, and these two parts are pressed together by forces C and D acting in the directions indicated by the arrows.



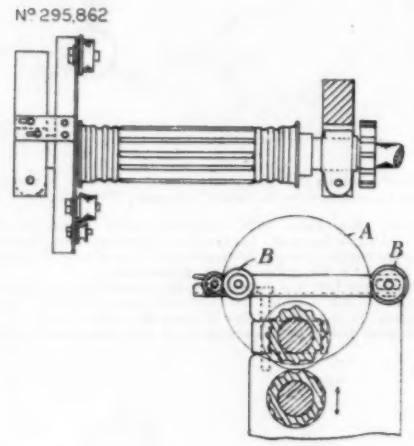
The mechanism constructed in accordance with the invention is shown in the lower drawing. The vertical contact lever E is provided with a contact which may be moved into engagement with a contact brush F by hand or otherwise, and at its lower end it is connected by a copper band G to the electromagnet, the contact pressure being maintained by means of a spring H which engages at the pivot J of the lever E. The pivot is slightly relatively movable in a slot. The coupling part K is secured to

the vertical contact lever E, which is pulled back by a spring L, and the coupling part M is secured to a member N. The coupling parts are pressed against one another in the direction of the arrow by means of a bell crank member Q acted upon by a spring-controlled bar R which may form part of a hand-operated link mechanism, and the pressure is adapted to be released under the control of an electromagnet S arranged in the circuit to be interrupted, through the intermediary of another member T connected to the bell cank lever Q and armature U of the electromagnet.—*August 23rd*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

295,862. October 20th, 1927.—Making Metal Tubs, W. P. Butterfield, Ltd., Tank Works, Otley-road, Baildon, Shipley, Yorks.; and F. Wood.

The inventors propose to make metal tubs with both longi-

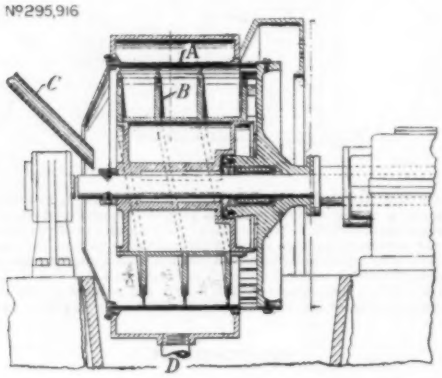


tudinal and circumferential corrugations. For this purpose a special type of roll is employed, as shown in the illustrations. The tub A is supported by the guide rollers B B during the process of corrugation. The upper roll is hinged so that the finished tub can be removed.—*August 23rd*, 1928.

WATER PURIFICATION.

295,916. March 20th, 1928.—Centrifugal Machines, *A. E White*, 88, *Chancery-lane, London, W.C. 2.*

This filter is of the centrifugal type, with a drum-like screen A, which is driven at a speed of about 800 revolutions per minute.

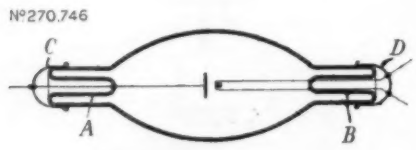


Within it there is a worm B touching the screen and driven a few revolutions slower. The feed shoot is shown at C and the outlet for the fines or water at D. The material which cannot pass the screen is pushed to the right by the worm and escapes through the end plate.—*August 23rd*, 1928.

MISCELLANEOUS.

270,746. May 6th, 1927.—Improvements in or relating to High-tension Electric Discharge Vessels, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemenstadt, Germany.

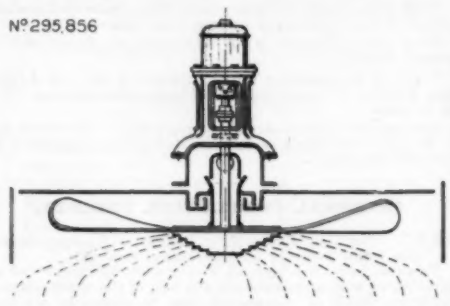
In electric discharge vessels, more particularly in those for high tension as, for instance, in hot cathode tubes, spray or brush discharges are liable to be produced on the supply wires or leads to the electrodes. In accordance with this invention the glass



recesses A and B are provided at the surfaces facing the wires or leads with a metallic coating or lining which is in direct connection with the anode lead in the case of the covering in the recess A and with one of the two leads in the case of the recess B. Caps C and D are provided at the ends of the glass vessel. The conducting lining may be made of silver, platinum, copper, or tin, and it may be produced chemically by electrolysis.—*August 7th*, 1928.

295,856. October 10th, 1927.—Means of Effecting an Intimate Contact Between Gases and Liquids which have to React Upon Each Other, H. Petersen, 6, Hohenzollernstrasse, Berlin-Steglitz, Germany.

This apparatus is intended for such purposes as the scrubbing of gases or the manufacture of acids. Claim is made for:—Means permitting an intimate contact to be obtained between gases and liquids which have to react upon each other within a reaction enclosure, comprising a propeller or like blade which extends substantially across the entire section of the enclosure in which the blade is so positioned near one wall thereof, that it imparts a strong continuous whirling motion to the whole of the gases contained in the reaction enclosure, increasing considerably



the speed of the gases and the length of their path through this enclosure without causing by itself the admission or the removal of the gases from the reaction space.—*August 23rd*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Chemical Engineering Group.—In the House of the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Factory Floors," by Mr. F. Heron Rogers. 8 p.m.

Junior Institution of Engineers.—At 39, Victoria-street, S.W. 1. Lecture, "Interesting Details of Swiss Alpine Railways," by A. J. Simpson (Member). Illustrated by special slides. 7.30 p.m.

SATURDAY, OCTOBER 6TH.

Electrical Power Engineers' Association: Southern Division.—Hotel Cecil, Strand, W.C. 2. The tenth annual dinner to the members of the National Executive Council, at 5.30 for 6 p.m. Tickets may be obtained from P. Gordon Hieatt, hon. secretary, Southern Division, 25, Parkhurst-road, Bowes Park, N. 22.

Institute of British Foundrymen: Lancashire Branch.—The College of Technology, Sackville-street, Manchester. Presidential address by Mr. E. Longden. Paper, "Oxygen and Metals: Some Features in their Relationship," by Professor F. Johnson, D.Sc.

Institution of Municipal and County Engineers.—Joint meeting of the South Wales District and the Institution of Civil Engineers (South Wales Association), to be held at Cardiff. Assemble at the City Hall, Cardiff, 10.15 a.m.

Institution of Municipal and County Engineers.—North-Western District Meeting at Stockport. Assemble at Stockport Town Hall at 11 a.m.

MONDAY, OCTOBER 8TH.

Institute of Transport.—In the Lecture Theatre, Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. "Commercial Aviation in Relation to Other Forms of Transport," by Air Vice-Marshal Sir W. Sefton Brancker, K.C.B., A.F.C.

The Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Mr. S. E. Flack, Chairman will deliver an address. 7.30 p.m.

TUESDAY, OCTOBER 9TH.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. "Turbo Charging of Internal Combustion Engines, especially Diesel Engines," by Dipl.-Ing. A. Buchi. 6.30 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Functions of Regenerators in Relation to the Refractory Materials of Construction," by Mr. A. T. Green. 7.30 p.m.

The Institute of Metals: North-East Coast Local Section.—In the Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address by Dr. J. A. Smyths. 7.30 p.m.

WEDNESDAY, OCTOBER 10TH.

Northampton Engineering College Engineering Society.—St. John-street, London, E.C. 1. "Stars and Stellar Matter," by Mr. S. C. Laws. 5.30 p.m.

The Institute of Fuel.—At the Chemical Society's Rooms, Burlington House, Piccadilly, W. 1. Mr. T. A. Peebles, of Pittsburgh, will read a paper on "Automatic Combustion Control of Liquid, Solid and Gaseous Fuels." 6 p.m.

The Institute of Metals: Swansea Local Section.—In the Thomas Café, High-street, Swansea. Chairman's address by J. H. Grant. 7 p.m.

THURSDAY, OCTOBER 11TH.

Optical Society.—At the Imperial College of Science and Technology, South Kensington, S.W. 7. The following papers will be presented and discussed:—"Lenses and Equipment for Ultra-violet Photography," by Colonel J. William Gifford, F.R.A.S.; "Some Remarks on Old English Objectives," by Mr. H. Boegehold, Ph.D.; "On the Development of Spectacles in London from the End of the Seventeenth Century" (first paper on the Court Collection), by Mr. Thomas H. Court and Professor Moritz von Rohr, Ph.D., Hon. M.D. Illustrated by exhibits from the Court Collection. 7.30 p.m.

The Institute of Metals: London Local Section.—In the rooms of the Society of Motor Manufacturers and Traders, Ltd., 83, Pall Mall, S.W. 1. Chairman's address by Dr. S. W. Smith. 7.30 p.m.

FRIDAY, OCTOBER 12TH.

Diesel Engine Users Association.—19, Cadogan-gardens, S.W. 13. "Marine Oil Engines," by Mr. Sterry B. Freeman. 5.30 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. Chairman's address, by Mr. I. H. Hedley. 7.15 p.m.

Junior Institution of Engineers.—At 39, Victoria-street, S.W. 1. Ordinary Meeting. Paper, "The Use of Instruments in the Boiler-house," by F. Squirrell (Member). Slides. 7.30 p.m.

Manchester Association of Engineers.—The Engineers' Club, Albert-square, Manchester. President's address, by Mr. W. G. Gass. Followed by a smoking concert. 7.15 p.m.

The Institute of Metals: Sheffield Local Section.—In the Non-Ferrous Section, Applied Science Department of the University, St. George's-square, Sheffield. "Alternating Current Electrolysis," by R. D. Barklie; "Sodium Cyanide in Silver Plating," by Dr. E. E. Sanigar. 7.30 p.m.

SATURDAY, OCTOBER 13TH.

Institute of Marine Engineers.—85–88, The Minories, Tower Hill, London, E. 1. Junior Section. Social gathering and dance. 7 to 11 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Visit to the L.N.E.R. electric car sheds at Gosforth. 3 p.m.

MONDAY, OCTOBER 15TH.

Bradford Engineering Society.—Technical College, Bradford. "Electricity Supply in Rural Areas," by Mr. R. Alan Thwaites. 7.30 p.m.

The Institute of Metals: Sheffield Local Section.—Conjoint meeting in the Non-Ferrous Section, Applied Science Department of the University, St. George's-square, Sheffield. Sorby Lecture, "Influence of Pressure on Rocks and Metals," by Mr. Cosmo Johns. 7.30 p.m.

WEDNESDAY, OCTOBER 17TH.

The Newcomen Society.—At the Science Museum, South Kensington, S.W. 7. "Early Days of Railway Signalling," by Mr. W. H. Deakin. 5.30 p.m.

THURSDAY, OCTOBER 18TH.

The Institute of Metals: Birmingham Local Section.—In the Engineers' Club, Waterloo-street, Birmingham. 7 p.m.

Institution of Mechanical Engineers.—Annual Dinner, Mayfair Hotel, London. 6.45 for 7.15 p.m.

Royal Aeronautical Society.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Light Alloys and Their Use in Aircraft," by Mr. H. Sutton. 6.30 p.m.

University of London, University College.—Gower-street, London, W.C. 1. "Naval Bases and Sea Power," by Captain C. J. C. Little, C.B., A.D.C., R.N. 5.30 p.m.

FRIDAY, OCTOBER 19TH.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. General meeting. Presidential address by Mr. Richard W. Allen. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Technical Advertising," by Mr. R. H. Sharp. 7.30 p.m.

MONDAY, OCTOBER 22ND.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Graduates' Section. "Compressed Air for Mining and Industrial Purposes," by Mr. H. R. Steward. 6.30 p.m.

THURSDAY, OCTOBER 25TH.

Chadwick Public Lecture.—At the Royal Institute of British Architects, 9, Conduit-street, W. 1. Lecture, "Public Health Buildings and Recent Improvements in Town Development in Sweden," by Mr. Torben Grut. 5 p.m.

FRIDAY, OCTOBER 26TH.

Institution of Electrical Engineers: North-Eastern Students' Section.—Electrical Engineering Lecture Theatre, Armstrong College, Newcastle-on-Tyne. "Post Office Telephones and the Public," by Mr. L. B. Harmer. 7.15 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, London, S.W. 1. Informal meeting. "Mechanical Plant in Gasworks," introduced by Mr. R. C. Macdonald. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "Legal Protection for Originality and Inventions," by Mr. G. W. Tookey. 7.30 p.m.

MONDAY, OCTOBER 29TH.

Bradford Engineering Society.—Technical College, Bradford. "Time Recording and Costing," by Mr. A. H. Gledhill. 7.30 p.m.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Informal meeting. Discussion on "Our Profession from a Manufacturer's Point of View," to be opened by the President, Lieut.-Col. K. Edgcumbe, T.D., R.E.T., Retd. 7 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Coode, Fitzmaurice, Wilson and Mitchell inform us that they are carrying on business at 9, Victoria-street, Westminster, as heretofore, but under the name of Coode, Wilson, Mitchell, and Vaughan-Lee.

Maurice Warlow and Co., of 12, Victoria-street, London, S.W. 1, ask us to announce that they have been appointed by the Demag A.G., of Duisburg, Germany, as the representatives of that firm in Great Britain.

Thos. W. Ward, Ltd., of Sheffield, asks us to announce that it has purchased from Mr. R. S. Dalgliesh, of Newcastle, the High Yard portion of Spencer's engineering works and steel foundry at Newburn-on-Tyne. The same firm last year acquired the extensive rolling mills and steelworks adjoining. It is understood that dismantling operations will commence shortly.

Stothert and Pitt, Ltd., of Bath, ask us to state with regard to the note concerning Burn Transmissions, Ltd., which was published under the heading of "Personal and Business Announcements" in our issue of September 21st, that Burn Transmissions, Ltd., will work under a licence to be granted by Stothert and Pitt, Ltd., and Mr. Burn, the joint owners of the patents. Stothert and Pitt, Ltd., continue to manufacture "Burn" gears.

We are informed that an arrangement has been effected between Gilbert Gilkes and Co., Ltd., of Kendal, and James Gordon and Co., Ltd., of Kingsway, London, whereby their respective businesses, so far as the manufacture and supply of water-power plants and hydraulic works generally are concerned, have been amalgamated. The business is now being carried on under the title of "Gilbert Gilkes and Gordon, Ltd." James Gordon and Co., Ltd., will still continue their business as combustion engineers, at Windsor House, Kingsway, as heretofore, and the London Office of Gilbert Gilkes and Gordon, Ltd., will now be at the same address.